

ANNUAL UTRAC WORKSHOP ON TRANSPORTATION RESEARCH NEEDS

2006 PROCEEDINGS

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December 2006

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UDOT RESEARCH & DEVELOPMENT REPORT ABSTRACT

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16. Abstract An annual workshop (known as the UTRAC Workshop) was held on March 21, 2006 to discuss and prioritize the research needs of the Utah Department of Transportation (UDOT). Participants included UDOT managers and employees, Federal Highway Administration (FHWA) staff, individuals from other government agencies, researchers from the local Universities, consultants, contractors, and other interested parties. Problem Statements, describing research needs of the Department, were submitted prior to the workshop and then evaluated, modified, and prioritized by working groups at the workshop. This document describes UDOT research prioritization process, the UTRAC workshop and the resulting list of prioritized Problem Statements. The UTRAC Workshop included a plenary session, with a keynote address by UDOT Executive Director John Njord, P.E., an update on the status of various research projects, and the presentation of the Trailblazer Award to Dr. Lawrence D. Reaveley, Chair of the University of Utah Civil and Environmental Engineering Department, for his ardent support of transportation research. Much of the workshop was devoted to the evaluation of Problem Statements by groups of people organized by topic area. The nine topic area groups were: construction, maintenance, materials and pavements, environmental, planning and asset management, traffic management and safety, geotechnical, structural, and hydraulics. Each group used a voting process to determine the most important research needs in their discipline, in ranked order. A total of 64 Problem Statements were considered at the workshop, and 34 statements were prioritized. Of those 34 statements, the top 19 have been listed for potential funding by the Research Division, including the top two statements from each topic area group. The workshop was held at the Salt Lake Community College Miller Campus, in Sandy Utah. A total of 118 people participated in the workshop.					
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EXECUTIVE SUMMARY

The Research Division of the Utah Department of Transportation (UDOT) held its annual UTRAC Workshop on March 21, 2006, at the Salt Lake Community College Miller Campus, in Sandy Utah. The purpose of the workshop was to discuss and prioritize the research needs of the Department, in preparation for the 2007 Fiscal Year. Attending the workshop was 118 people from various divisions within UDOT, the Federal Highway Administration (FHWA), other government agencies, the three research Universities in Utah, consultants, contractors, and other interested parties.

Initiated in 1993, the Utah Transportation Research Advisory Council (UTRAC) workshop has provided guidance to the UDOT Research Division in the allocation of research funding and efforts. Research needs are identified by Problem Statements, which were submitted in advance of the workshop. These Problem Statements were then evaluated, modified, and prioritized by nine discipline area working groups at the workshop. Each group used a voting process to determine the most important research needs in their discipline, in ranked order. The discipline area groups were: construction, maintenance, materials and pavements, environmental, planning and asset management, traffic management and safety, geotechnical, structural, and hydraulics.

This year, a total of 64 Problem Statements were considered at the workshop, and 34 statements were prioritized. Of those 34 statements, the top 19 have been listed for potential funding by the Research Division, including the top two statements from each topic area group.

The UTRAC Workshop also included a plenary session, with a keynote address by UDOT Executive Director John Njord, P.E. Mr. Njord described the ways in which UDOT has employed innovation in the transportation industry to become a leader in the country, and to improve the way the Department serves the public in Utah.

During the plenary session, the UTRAC Trailblazer Award was presented to Dr. Lawrence D. Reaveley, Chair of the University of Utah Civil and Environmental Engineering Department, for his ardent support of transportation research. Dr. Reaveley is a recognized expert in the field of bridge design, and has provided important contributions to UDOT in the areas of seismic bridge response, concrete design, and bridge deck cracking. He is the 12th recipient of this important award.

This report summarizes the agenda and proceedings of the 2006 UTRAC Workshop, and presents the final list of Problem Statements recommended for funding and the priority lists developed by each of the discipline area working groups. A list of all the Problem Statements considered during the workshop, and the complete text of each Problem Statement, is also included.

The 19 Problem Statements ranked for potential funding are shown below, including the funding priority, the Problem Statement number and title, the discipline area each falls within, and the approximate budget anticipated.

<u>Funding Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Discipline</u>	<u>Approx Budget</u>
1	06.01-2	Quality and Safety During Nighttime Construction Activities	Construction	\$10,000
2	06.02-6	Pavement Distress in 9.5mm vs. 12.5 Asphalt on Thin Overlays	Maintenance	\$35,000
3	06.03-6	Validate Hamburg Wheel Tracker using Field Tested Superpave Mixes	Materials & Pavements	\$60,000
4	06.04-4	Development of an Indirect Wildlife Impact Methodology	Environmental	\$96,000
5	06.05-6	Seismic Vulnerability and Emergency Response of UDOT Lifelines	Planning & Asset Mngmnt	\$90,000
6	06.06-3	A Safety Analysis of Fatigue and Drowsy Driving	Traffic Mngmnt & Safety	\$39,500
7	06.07-6	Stone Column Treatment with Wick Drains in Silty Sands	Geotechnical	\$30,000
8	06.08-1	Evaluation of Bridges for Seismic Retrofit	Structural	\$120,000
9	06.09-1	Fish Passage at Utah Culverts: Strategy, Assessment, and Design (also ranked #2 by Environmental Group)	Hydraulics	\$74,000
10	06.07-3	Assessment of Mud Balance Test for Quality Assurance in Ground Anchor Installation (also ranked #6 by Materials Group)	Geotechnical	\$4,000
11	06.01-3	GIS Project Tracking Website	Construction	\$95,000
12	06.06-2	Evaluation of the Safety and Design Integrity of Two-Lane Rural Highways Using the Interactive Highway Safety Design Model (IHSDM) Developed by FHWA	Traffic Mngmnt & Safety	\$47,700
13	06.03-2	Asset Improvement Tracking – (construction history) (also ranked #3 by Planning Group)	Materials & Pavements	\$30,000
14	06.02-1	Install Avalanche Monitoring System	Maintenance	\$100,000
15	06.07-10	Development of MSE Wall Inspection Plan Based on Failure Mode Analysis and Risk Assessment	Geotechnical	\$40,000

16	06.07-5	Improved Performance of MSE Walls	Geotechnical	\$25,000
17	06.09-2	Estimating Peak Flow Statistics for Ungaged Streams in Utah-Development of Regional Flow Characteristic Regression Models and web-based, GIS Model User Interface	Hydraulics	\$35,000
18	06.05-7	Calibration and Validation of I-15 VISSIM model	Planning & Asset Mngmnt	\$30,000
19	06.08-2	Calibration of AASHTOs New Prestress Loss Design Equations	Structural	\$80,000

INTRODUCTION

The UDOT Research Division is charged with promoting, executing and implementing research activities within the Utah Department of Transportation, to further the mission of the Department and increase the Department's use of new products and techniques. A key component in the execution of this charge is the UTRAC Workshop, a collaborative, annual event held to discuss and prioritize the research needs of the Department.

The 2006 UTRAC Workshop was held on March 21, 2006, at the Salt Lake Community College Miller Campus, in Sandy Utah. The results of this Workshop will contribute significantly to the development of the UDOT Research Work Program for the 2007 Fiscal Year.



The UTRAC Workshop also serves to satisfy federal regulations relating to the use of federal research funds. Research efforts at UDOT are supported largely by federal funds. Federal regulation mandates that the states certify the proper use of these funds, and stipulates that they develop, establish, implement and document a management process that identifies and implements research, development and technology transfer activities to address priority transportation issues. The UTRAC Workshop is a key element in the "identification" portion of this process, and aids the Division in the allocation of research funding and efforts.

Initiated in 1993, the UTRAC Workshop is named for the Utah Transportation Research Advisory Council, a group of UDOT leaders who previously oversaw the prioritization process. In the application of this process, the Research Division invites UDOT staff and other interested parties to gather to evaluate and prioritize UDOT's research needs.

Attending the 2006 workshop were 118 people from various divisions within UDOT, the Federal Highway Administration (FHWA), other government agencies, the three research Universities in Utah, consultants, contractors, and other people with interest in transportation research.

Research needs are identified by Problem Statements, which were submitted in advance of the workshop. These Problem Statements were then evaluated, modified, and prioritized by nine discipline area working groups at the workshop. The discipline area groups were: construction, maintenance, materials and pavements, environmental, planning and asset management, traffic management and safety, geotechnical, structural, and hydraulics. Each group used a voting process to determine the most important research needs in their discipline, in ranked order.

This year, a total of 64 Problem Statements were considered at the workshop, and 34 statements were prioritized. Of those 34 statements, the top 19 have been listed for potential funding by the Research Division, including the top two statements from each topic area group. Lists of the prioritized Problem Statements, and the complete text of each Statement, are included in this Proceedings document.

This Proceedings also includes the agenda of the Workshop, the text of the keynote address by UDOT Executive Director John Njord, the presentation of the UTRAC Trailblazer Award to Dr. Lawrence D. Reaveley, Chair of the University of Utah Civil and Environmental Engineering Department, and other information from the Workshop.

RESEARCH PRIORITIZATION PROCESS

Process Overview

The process of prioritizing research needs for the Utah Department of Transportation (UDOT) is based around a collaborative, annual workshop, organized by the UDOT Research Division. This workshop has come to be known as “UTRAC”, the acronym for the Utah Transportation Research Advisory Council, a group of UDOT leaders who previously oversaw the prioritization process. In the current prioritization process, UDOT staff, FHWA staff, key consultants, research partners, contractors, and people from associated agencies gather to evaluate and prioritize UDOT’s research needs. These needs are defined by Problem Statements that were submitted by many parties prior to the workshop. Available funding is applied to the highest priority Problem Statements, as determined during the workshop through a voting process.

The annual UTRAC Workshop was initiated in 1993, and has been a very successful process. The process has been modified several times, and underwent some significant revisions in 2005.

The key steps employed in the 2006 research prioritization process at UDOT are shown below. Although the UTRAC Workshop played a central role in the process (step 6), a number of steps were needed before and after the workshop to make the process complete. The steps were:

1. Identified key leaders in the Department to lead the Problem Statement generation process in each of nine discipline areas. Those areas were:
 - a. Construction
 - b. Maintenance
 - c. Materials & Pavements
 - d. Environmental
 - e. Planning & Asset Management
 - f. Traffic Management & Safety
 - g. Geotechnical
 - h. Structural
 - i. Hydraulics
2. Assigned a person from the Research Division staff to work with each discipline group.
3. Provided background information to the group leaders on the prioritization process and their role within it.
4. Solicited Problem Statements from each of the discipline groups (and other stakeholders), making the leader for that group responsible to lead the Problem Statement development



process. The Problem Statement submission deadline was set about one month ahead of the workshop. Emphasized the need to identify a key UDOT Champion for each Problem Statement, and a plan for implementation. Problem Statements were accepted from any entity, and did not need to come through the discipline group or its leader. Tools provided to each group leader included:

- a. List of Problem Statements from the past year.
 - b. Problem Statement form (revised from previous years).
 - c. Suggestions about coordinating with contractors, consultants and key researchers during this early stage in the process to ascertain their needs, interests and resources.
5. Research Division staff contact for each discipline group reviewed the submitted Problem Statements. Their review included a literature search to determine if similar work had been performed in Utah or elsewhere, or if significant knowledge on the topic could be provided to the discussion. Project scopes were evaluated to insure that well-defined work tasks and clear deliverables were envisioned. Implementation plans were also required in the scope statements. As needed, revised Problem Statements were proposed to the group leaders.
6. Convened a one-day workshop to review the Problem Statements and prioritize them. The workshop included 118 people from UDOT, FHWA, key consulting and construction firms, the three research universities in Utah, other state agencies, and the public. Elements of the workshop included:

- a. Keynote address from Mr. John Njord, P.E., the UDOT Executive Director, discussing innovations used by UDOT in recent years, and encouraging further innovation.
- b. Presentation of the status of research projects initiated during the 2005 UTRAC Workshop.
- c. Divided into nine working groups to evaluate the Problem Statements, discuss scopes and deliverables, and establish priorities. Background information was presented by the authors of the Statements, and by the Research Division contact. A total of 64 Problem Statements were evaluated by the groups. The number of submitted Problem Statements per group ranged from three to twelve.
- d. Prioritized the statements through a two-step voting process using weighted ballots that minimized the ability of any one subgroup to dominate the process (UDOT participants dominated the voting scheme, irrespective of the number of people present).
- e. During breaks throughout the day, groups were able to interact to share ideas, gather supporting information, and provide input on cross-discipline problems.
- f. Each discipline group concluded the workshop by submitting a list of their top three to six projects, in order of priority.



7. Research Program Manager assembled the prioritized Problem Statements from each discipline group into a master list of research priorities. This list included the 34 Problem Statements.

8. Sorted the assembled Problem Statement list by order of priority, so that the number one priority of each discipline group was shown first, followed by the number two priorities, and so on.
9. Applied the available research funding to the priority-order Problem Statement list, starting at the top of the list and working down, yielding a list of about 19 projects which could be funded in fiscal year 2007.
10. Presented the priority list and funding scenario to the Research Division Director for input and approval.
11. Assigned Research Division staff as Project Managers for each of the projects, and discussed possible Principal Investigators for each.
12. Submitted the final funding list for approval by the Department and FHWA, as part of the annual Research Program funding document.
13. Initiated the research projects.



2006 UTRAC Workshop Team

Each year, it takes a large group of people to organize and execute the UTRAC Workshop. The following people were involved in 2006:

Director of Research and Bridge Operations: Rukhsana (Shana) Lindsey

Chair of UTRAC Event: Blaine D. Leonard

Workshop Logistics Team: Esther Olsen, Elaine Chatfield, Rae Ann Jensen, Raeleen Maxfield

FHWA Liaison: Paul Mooney

Discipline Group Leaders and Research Contacts:

Group 1: Construction

Group Leader: Darrell Giannonatti
Research Advisor: Michelle Page

Group 2: Maintenance

Group Leaders: Rich Clarke / Kevin Griffin
Research Advisor: Barry Sharp



Group 3: Materials & Pavements	
Group Leader:	Tim Biel
Research Advisor:	Doug Anderson
Group 4: Environmental	
Group Leader:	Jerry Chaney
Research Advisor:	Doug Anderson
Group 5: Planning & Asset Management	
Group Leader:	Kim Schvaneveldt
Research Advisor:	Abdul Wakil
Group 6: Traffic Management & Safety	
Group Leader:	Richard Manser
Research Advisor:	Ken Berg
Group 7: Geotechnical	
Group Leader:	Darin Sjoblom
Research Advisor:	Blaine Leonard
Group 8: Structures	
Group Leader:	Boyd Wheeler
Research Advisor:	Daniel Hsiao
Group 9: Hydraulics	
Group Leader:	Michael Fazio
Research Advisor:	Debbie Heim

2006 UTRAC Workshop Basic Agenda

The UTRAC Workshop was held on March 21, 2006, at the Salt Lake Community College Miller Campus, in Sandy Utah. The workshop was attended by 118 people from various divisions within UDOT, the Federal Highway Administration (FHWA), other government agencies, the three research Universities in Utah, consultants, contractors, and others. The workshop consisted of two main sessions and three breakout sessions. During the breakout sessions, discipline groups discussed, modified, and prioritized Problem Statements. The complete Workshop Agenda is included in the Appendix of this report. The basic outline of the sessions was as follows:

Introductory Plenary Session:

Welcome – Rukhsana Lindsey, Director of Research
 Keynote Address – John Njord, UDOT Executive Director
 Research Program Status – Blaine Leonard, Research Project Manager
 Workshop Instructions - Blaine Leonard, Research Project Manager

First Breakout Session:

Problem presentations, discussion, and first prioritization voting



Lunch Session:

Presentation of Trailblazer Award – Rukhsana Lindsey, Dir. of Research

Award of Door Prizes – Barry Sharp, New Products Coordinator

Second Breakout Session:

Problem Statement Refining: Objectives, Tasks, Benefits, Implementation

Third Breakout Session:

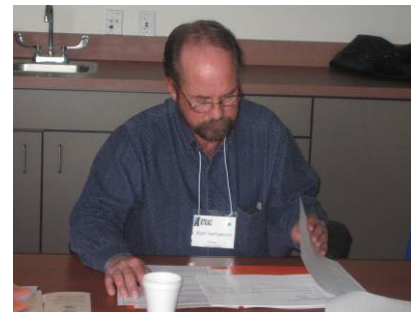
Problem Statement refinement & discussion:

Deliverables, Tasks & Budget

Final Prioritization Voting

Completion of Workshop Feedback and Evaluation

Each workshop participant was given a packet of information, which included an agenda, a list of breakout groups and room assignments, a list of all the Problem Statements being considered by each group, and a copy of each of the Problem Statements being considered by the group the participant is assigned to. The Group Leader and Research Advisor assigned to each group were each given a binder containing a copy of every Problem Statement being considered by all the groups, ballots for voting in their group, and a spreadsheet (on disk) to be used to tally the ballots. They were also given an instruction sheet on how to manage the group and the voting process.



WORKSHOP ACTIVITIES

Opening Remarks

Shana Lindsey, Research and Bridge Operations Director

I would like to welcome all of you to this years UTRAC workshop. We have over 139 people registered for this workshop, so I'm really excited for this event.

We appreciate all of you taking time to come together for this important effort. This UTRAC workshop is an opportunity for all of you. It is an opportunity to get together and decide where we should spend our research efforts for the year. It is also an opportunity for all of you to network with all of our partners. Hopefully you will all take advantage of this opportunity today.

I would like to introduce our keynote speaker, UDOT Executive Director, John Njord.

John has been the Executive Director of the Utah Department of Transportation since June of 2001, where he leads a team responsible for the planning, design, construction and maintenance of Utah's transportation system. Mr. Njord joined the Department in 1988, serving in various engineering capacities. In 2004, Mr. Njord was President of AASHTO. In 2005, he was the Chairman of the Executive Committee of TRB. It was quite interesting for me during that time, because as I traveled, and mentioned that I was from Utah, everyone associated me with John Njord and all the good things that he is all about. So that was an awesome experience.

We thank you, John, for agreeing to be our keynote speaker.

Keynote Address

John Njord, P.E., Executive Director, Utah Department of Transportation

It is a pleasure to be here with you this morning. When Shana asked me to come and speak with you for a moment this morning, I was honored to do so. As I thought about what I ought to say this morning, I realized that there is so much that I could say about where we are in the world of delivering transportation to the citizens of Utah. I could spend the whole morning discussing this. I promise I won't do that, but there are so many exciting things that are taking place in the business that we are in right now.

Later this summer we are going to celebrate the 50th year Anniversary of the commencement of Interstate system in our country. It started with President Eisenhower back in 1956. As I look around the room, I think that there are probably none of us that were involved with this business back in that time, except maybe Doyt Bolling.





We have seen lots of terrific things that have taken place over the last 50 years in building this interstate system that we rely on in our country and in our state. The next 50 years, I believe, will be more challenging than the last 50 years, and more exciting in many different ways. Here at the Department of Transportation, we have reinvented ourselves a number of times over the last number of years. We have reinvented the way we do business, the way we deliver projects, and the way that we go about our business. This has helped redefine the way that people across the country approach their work.

It is odd to think that a Department of Transportation in a small state like Utah could have that kind of effect, but still today, the I-15 Reconstruction Project here in Salt Lake County is the standard upon which all design-build projects across the country are measured. It is still the gold standard. Everyone measures their success in design-build against what we did here in Utah with our design-build project.

We've had other accomplishments in this Department that have become the standards across the country as well. We are about to launch one of those even as we speak, the Legacy Highway project. When we are completed with that, I believe it will be the standard upon which parkways are built across the entire nation. And that is a great place to be in developing new ways of delivering the products that our customers so desperately want.



We just completed a legislative session in our state, and it was a very interesting session in as much as this state had a surplus, a surplus of over a billion dollars. It was interesting to see the various battles that were going on in the legislature to deliver \$10,000 here, \$100,000 there; in some cases a million dollars for this program and that program. All the while, us in the transportation business just kind of sat back and watched it and advocated for our position when we needed to. And when the dust cleared, we saw a record year for transportation funding in the state of Utah. Those of you with UDOT realize that you are now involved in a \$1.2 billion dollar a year business here in the state of Utah. There were \$440 million dollars of general funds that were delivered to the Transportation Department above and beyond our regular program. That is a record high; it is higher than ever in the 110-year history of the state of Utah. \$440 million dollars!

Why did that happen? Upon reflection, there are a number of reasons for it. We have terrific people within this organization that have worked tirelessly to serve the citizens of our state. We have their confidence; they believe in what we do, and they love what we do. And, they love the way that we deliver it.

When the Legislature was divvying out these \$10,000 batches, and \$100,000 batches, they were not counting in the millions, they were counting in the tens of millions and the hundreds of millions that they wanted to deliver to UDOT. And, now the challenge for us is to deliver, once again, and we are up to that task. I have no question about that. We will deliver and we will again be able to address some very significant transportation challenges.

It's a great time to work in transportation, because it fits into where our state is going. I am very encouraged by the leadership of Governor Huntsman. He is leading us towards developing new economic opportunities within our state. He is leading us towards higher paying jobs, a

better economy, and a higher quality of life. He realizes that transportation is the foundation upon which all that is built. He understands that in order to build quality of life opportunities within our state, to build opportunities for businesses to come in here and develop jobs, that we must have a great transportation system in place first. I am encouraged by that. That is a great situation for those of us working in the transportation field in the state of Utah.

This forum that we have here today is a great opportunity. It allows us to gather together to talk about research and opportunities to deliver our projects better, faster, and with higher quality, to make our projects longer lasting and more beautiful. All of those attributes are things that our customers are looking for. And as I reflect upon how we decide how to do research within the state of Utah, I am very proud and honored to be part of this process. Many states do not do the kind of thing that we are doing here, in gathering together to decide collectively how to spend research money. I am proud of the way that it is done here. We actually won an award, this year, the AASHTO President's Award for Research for this process that we are all involved with here. Once again, we are setting a precedent on how to go about our business, a precedent which is seen across the country. So, I am proud of what you do, and I look forward to the products that you are going to deliver.

I hope that as you go through this process that you will focus on those things that are most important to efficiently delivering transportation for Utah. Keep in mind who the end customer is, as you are deliberating about the various research projects that you want to do. Who is our end customer and how do we best satisfy their need? As you keep that in mind, I have no doubt that what will come out will be some great research projects that will enable us to do our work much better in the future.

I applaud you for what you do, and I encourage you to continue. We have great partnerships with some great Universities here in our state, Universities that I am very proud of. I hailed from one of these, but I won't tell you which. Where is my red tie?

I look forward to the great products you deliver from this workshop. Thank you very much.

UTRAC Trailblazer Award



The 12th UTRAC Trailblazer Award for Outstanding Contributions to Transportation Research

2006 Recipient

Lawrence D. Reaveley, PhD, P. E.

Award Citation - Presented by Rukhsana Lindsey, Director of Research

The Utah Department of Transportation Research Division is pleased to award the UTRAC Trailblazer Award for 2006 to Dr. Lawrence D. Reaveley, the 12th recipient of this award. Dr. Reaveley is currently the Chair and Professor of the University of Utah, Department of Civil and Environmental Engineering. He has held this position since 1993, and has been associated with the University of Utah since 1970.

The Trailblazer Award is given each year to a person who has demonstrated excellence in contributing to the transportation field in Utah.

Dr. Reaveley, a recognized expert in bridges, structural concrete, and seismic design, is an aggressive advocate of research, innovation, engineering education, and the necessity of partnership between academia and industry. He has always been supportive of a wide range of

transportation related research, and an active participant in this research. He has recognized the importance of the interdisciplinary nature of transportation, venturing into economics, statistics, planning, and others.

Larry began his long engineering career, over 40 years ago, with UDOT, and he has maintained a close relationship with us ever since. Throughout his career in consulting engineering and academia, he has continued to be our supporter, and our critic. He has been a frequent participant in these UTRAC Workshops. He also has worked closely with UTA, the MPOs, and city governments.

Dr. Reaveley has been successful in bringing research dollars to the transportation field. He teamed with Dr. Loren Anderson and Dr. Kevin Womack of USU, and Dr. Les Youd of BYU to steer the I-15 National Testbed, a unique and very successful collaborative effort. Larry was able to acquire a massive loading frame, locate it on I-15 and test full size bridge sections. His pushover testing and composite wrap projects produced mountains of data, important conclusions, and are unique in the United States. He has provided us with valuable insight into the behavior of innovative bridge designs, and the causes and prevention of deck cracking.



Prior to his service to the university, Larry worked in the private sector as Vice President of Reaveley Engineering, one of Salt Lake City's premier engineering firms. His career has been a balance of academic, private and public service.

Among other awards, Larry has received:

- A Special Award for Implementation Action on the National Earthquake Hazards Reduction Program. USGS & FEMA in 1988.
- Named the Engineer of the Year by the Utah Engineers Council in 1989.
- The Governor's Medal for Science & Technology in 1996.

Dr. Reaveley has been associated with numerous societies and associations, and has contributed to the body of engineering knowledge, improved engineering practice, and broadly used codes and standards through his involvement with them. Some of these Societies include:

- American Concrete Institute
- American Society of Civil Engineers
- American Society of Engineering Education, and
- Chi Epsilon Civil Engineering Honor Society

Larry's professional service activities and publications are significant, and he holds two patents on the use of composites in structural members.

When Larry steps down as the chair of the department in a few months he will leave a positive mark on Utah transportation. We will miss him because he is a great engineer and a great guy.

For these reasons, and others too numerous to list here, we are honored to award the 2006 UTRAC Trailblazer Award to Lawrence D. Reaveley.

Acceptance Remarks - Lawrence D. Reaveley, Ph.D., P.E., Chair, Department of Civil and Environmental Engineering, University of Utah:

I want Shana to save that citation for my funeral, because one of those in all your life is enough.

I appreciate this award. You often hear people, especially quarterbacks, talking about how they couldn't have done accomplished something without their offensive line. I am more of an offensive lineman. I really appreciate so many people who worked together across the Universities to accomplish so much.



The I-15 National Test Bed research effort was out of this world, in terms of what it meant to the Universities. It established so many careers of our young faculty. I always think of myself as a lineman in this effort, knocking obstacles out of the way for some other people who really can do some fine things in those projects.

Now, I just told Doug Anderson earlier today, that I want to just lobby for one thing. I want you folks who are here, who are at the user level, influential people like Jon Bischoff, to argue and lobby for a distribution of research funds within UDOT that includes the level of research that allows our young professors to be here and participate. If we don't provide this level of research funding, if we are just in a technology transfer mode, the young professors can't afford to be here because they are going to be measured by a standard of publications that cannot be achieved. That is the way it is in their environment. It is not an abstract concept. So, in the balance of applied technology transfer research, I am not arguing for "basic" research, which is "Oh, look what I just observed, isn't that fun", but something in between. I am totally committed to applied research where we take some concept and apply it to make an improvement, and demonstrate to the UDOT administration that we have made a difference through our efforts. But let's not tighten that down to a point where our assistant professors can't afford to be here in this process. I want all of you to be advocates for this balance across the research programs. And that is all that I am going to say about that, Shana.

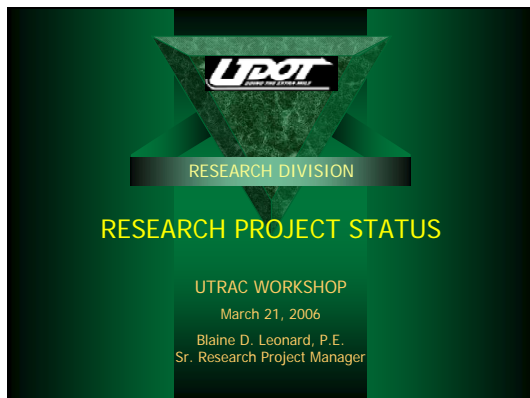
This workshop is a wonderful opportunity for everyone, for UDOT, for the academics, and for outside industry people. The outside industry people play an enormous role in this process with us, which is essential.

Thank you Shana. For a point guard, this is pretty nice.

Status of UDOT Research

Blaine D. Leonard, P.E., Research Program Manager

Thank you, John. I appreciate your time this morning. I appreciate your insightful words and your encouragement of our process.



I would like to take a few minutes this morning and talk just a little bit about the status of UDOT Research and the kinds of things we have been working on in this process over the last number of years.



Before I do that, and Michael Fazio might be the only one who really appreciates this, I would like to tell you that today is the birthday of Johann Sebastian Bach, the greatest musician that ever lived. So, this afternoon, in the afternoon break, when you get your brownie, if you have a candle in your pocket, you can put it in and light that up for good old Bach. He was born in Eisenach, Germany, and is 321 years old today.

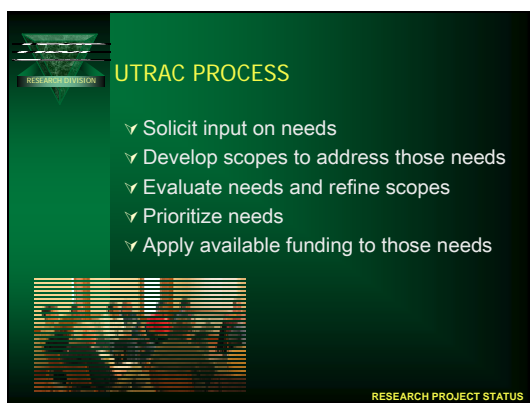


The UTRAC process was initiated in 1993, so we have been at this for quite a while. Over the years, a number of things have changed. But it is, as John said, the cornerstone of our research process, because it is here that we identify our needs, align our needs with UDOT's mission, and then match our funding with those needs so we can go on to build better tools for transportation tomorrow, and do the things that you need.

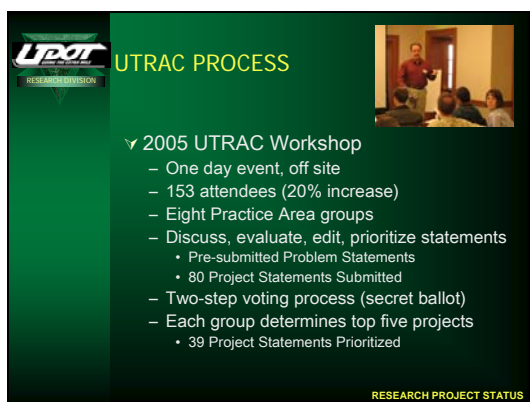
We have made some changes over the years, and made some significant changes to the process last year.



As John indicated, these changes garnered us an AASHTO President's Award for Research for this process. We have a process here that is different than the way it is done in a lot of other states. Over the past 6 or 8 months, since this award was announced, Shana has had a handful of questions from other research directors around the country, asking her how we do this, and getting ideas. We have shared a lot of this information with others so that they can try out some of the elements of this process that work for us.



Many of you have been involved with this before, but the process we are going to follow today has several steps: First, we solicit input on your needs. This comes from all of you in the form pre-prepared of Problem Statements. Our staff has evaluated those prior to the workshop. Each of these contains a scope that has been developed to address those needs. At this workshop you will evaluate those needs and refine those scopes and then prioritize them. Then, after this workshop, we will take the available research funding and apply them to those various needs, trying to get funding for at least the top project from each of the breakout groups, and then the second project, and so on.



In earlier years, this workshop was a two-day event, but recently, it has been compressed to a one-day event. Last year's workshop was held at Fort Douglas at the University of Utah. We had 153 attendees. We broke into eight groups and had 80 Problem Statements to consider. We went through the two-step voting process, using secret ballots (which is different than it was done in the past), and each group determined their priorities. Out of the eight working groups we ended up with 39 prioritized projects.



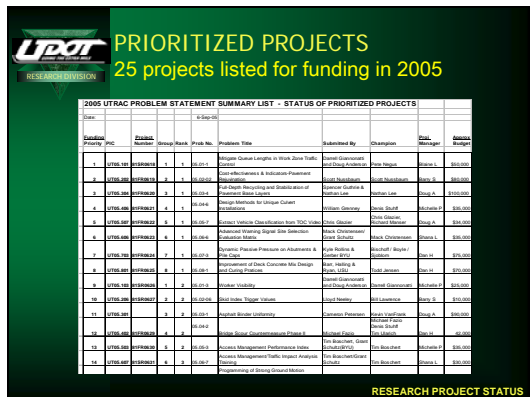
UTRAC PROCESS

- 2006 UTRAC Workshop
 - 140+ attendees
 - Nine Practice Area groups
 - 60 Problem Statements Submitted
 - Each group to determine top three to five problems

RESEARCH PROJECT STATUS

This year we have about 140 attendees registered. Instead of being in 8 groups we will be splitting into 9 groups. We have 60 Problem Statements that have been pre-submitted, and each one of you in your groups will look at those statements and try to prioritize the top three to five statements in your topic area.

Some of you will wander between topic areas to give your input and feedback into various groups, just depending on what your interest levels are.

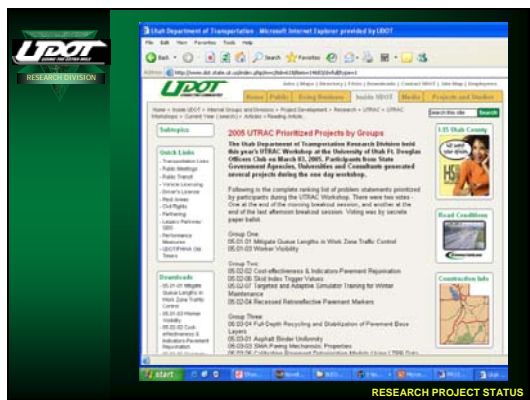


PRIORITIZED PROJECTS
25 projects listed for funding in 2005

Rank	Problem No.	Problem Title	Submitted By	Champion	Fund. Budget
1	05-01-01	Reduce Queue Lengths in West Zone Traffic Control	David Greenwald	John Meyer	\$10,000
2	05-01-02	Cost Effectiveness & Inductive Payment Reorganization	David Greenwald	John Meyer	\$10,000
3	05-01-03	Full Depth Recycling and Distribution of Pavement Base	David Greenwald	John Meyer	\$10,000
4	05-01-04	Asphalt Binder Uniformity	David Greenwald	John Meyer	\$10,000
5	05-01-05	Vehicle Detection from Toll Station	David Greenwald	John Meyer	\$10,000
6	05-01-06	Measurement of Truck Concrete Mix Design	David Greenwald	John Meyer	\$10,000
7	05-01-07	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
8	05-01-08	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
9	05-01-09	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
10	05-01-10	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
11	05-01-11	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
12	05-01-12	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
13	05-01-13	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
14	05-01-14	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
15	05-01-15	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
16	05-01-16	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
17	05-01-17	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
18	05-01-18	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
19	05-01-19	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
20	05-01-20	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
21	05-01-21	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
22	05-01-22	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
23	05-01-23	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
24	05-01-24	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000
25	05-01-25	Weather-Related Traffic Signal Control	David Greenwald	John Meyer	\$10,000

RESEARCH PROJECT STATUS

I realize that this spreadsheet is too small to read, but it indicates the status of the prioritized projects last year. We took the 39 problem statements that were prioritized and applied available research funding to them. The funding allowed 25 projects to be put on this list.



UTRAC Department of Transportation

2005 UTRAC Prioritized Projects by Groups

The Utah Department of Transportation Research Institute held the year's UTRAC Workshop at the University of Utah, St. George Campus on March 23, 2005. Participants from State Government Agencies, Universities and Consultants presented several projects during the one day workshop.

24 projects in the complete ranking list of problems, statements prioritized by participants during the UTRAC Workshop. There were two votes - one at the end of the morning breakout session, and another at the end of the last afternoon breakout session. Voting was by secret ballot.

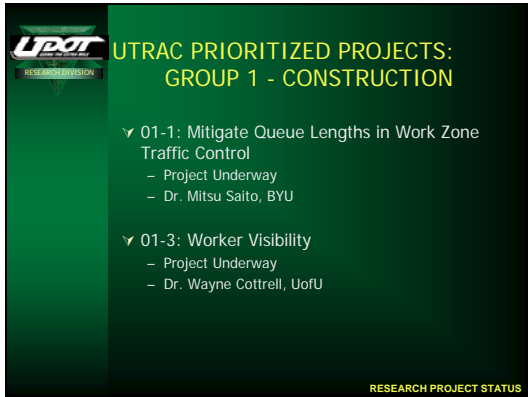
Group One
05-01-01 Mitigate Queue Lengths in West Zone Traffic Control
05-01-02 Weather Visibility

Group Two
05-01-03 Cost Effectiveness & Inductive Payment Reorganization
05-01-04 Full Depth Recycling and Distribution of Pavement Base
05-01-05 Asphalt Binder Uniformity

Group Three
05-01-06 Weather-Related Traffic Signal Control
05-01-07 Weather-Related Traffic Signal Control
05-01-08 Weather-Related Traffic Signal Control
05-01-09 Weather-Related Traffic Signal Control
05-01-10 Weather-Related Traffic Signal Control
05-01-11 Weather-Related Traffic Signal Control
05-01-12 Weather-Related Traffic Signal Control
05-01-13 Weather-Related Traffic Signal Control
05-01-14 Weather-Related Traffic Signal Control
05-01-15 Weather-Related Traffic Signal Control
05-01-16 Weather-Related Traffic Signal Control
05-01-17 Weather-Related Traffic Signal Control
05-01-18 Weather-Related Traffic Signal Control
05-01-19 Weather-Related Traffic Signal Control
05-01-20 Weather-Related Traffic Signal Control
05-01-21 Weather-Related Traffic Signal Control
05-01-22 Weather-Related Traffic Signal Control
05-01-23 Weather-Related Traffic Signal Control
05-01-24 Weather-Related Traffic Signal Control
05-01-25 Weather-Related Traffic Signal Control

RESEARCH PROJECT STATUS

If you are curious about last year's projects, the statements are all posted on our Research web site by topic area. You can click on this site and look at each of the projects that are on the funding list.



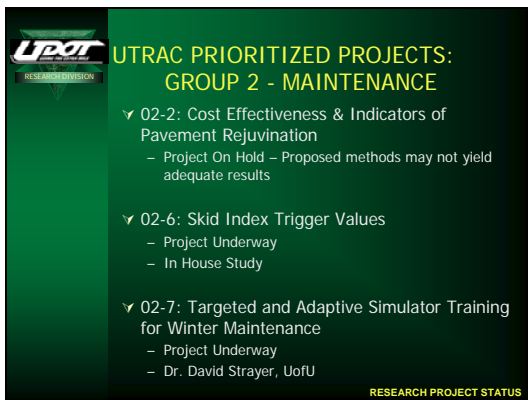
**UTRAC PRIORITIZED PROJECTS:
GROUP 1 - CONSTRUCTION**

- ✓ 01-1: Mitigate Queue Lengths in Work Zone Traffic Control
 - Project Underway
 - Dr. Mitsu Saito, BYU
- ✓ 01-3: Worker Visibility
 - Project Underway
 - Dr. Wayne Cottrell, UofU

RESEARCH PROJECT STATUS

I am not going to discuss the status of each project, but I am going to scan through a series of slides, group by group, to show you some of the projects that were prioritized for funding. You will notice that they haven't all been funded for one reason or another. Maybe we found out that someone else had already done a similar project, or there is an NCHRP study being done. As I run through these slides, you can get a quick idea of the status and progress of the 25 projects that were listed for funding last year.

These are the construction related projects.

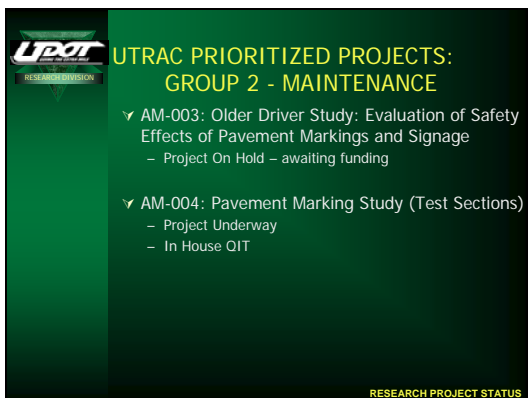


**UTRAC PRIORITIZED PROJECTS:
GROUP 2 - MAINTENANCE**

- ✓ 02-2: Cost Effectiveness & Indicators of Pavement Rejuvenation
 - Project On Hold – Proposed methods may not yield adequate results
- ✓ 02-6: Skid Index Trigger Values
 - Project Underway
 - In House Study
- ✓ 02-7: Targeted and Adaptive Simulator Training for Winter Maintenance
 - Project Underway
 - Dr. David Strayer, UofU

RESEARCH PROJECT STATUS

These are three maintenance related projects.




**UTRAC PRIORITIZED PROJECTS:
GROUP 2 - MAINTENANCE**

- ✓ AM-003: Older Driver Study: Evaluation of Safety Effects of Pavement Markings and Signage
 - Project On Hold – awaiting funding
- ✓ AM-004: Pavement Marking Study (Test Sections)
 - Project Underway
 - In House QIT

RESEARCH PROJECT STATUS

This next slide shows two more maintenance projects that are on the list.




**UTRAC PRIORITIZED PROJECTS:
GROUP 3 - MATERIALS**

- ✓ 03-4: Full-Depth Recycling and Stabilization of Pavement Base Layers
 - Project Underway
 - Dr. Spencer Guthrie, BYU
- ✓ 03-1: Asphalt Binder Uniformity
 - Project Underway
 - Raj Dongre, consultant
- ✓ 03-3: SMA Paving Mechanistic Properties
 - Project On Hold – awaiting funding

RESEARCH PROJECT STATUS

There are the materials projects. Most of them deal with pavements. Two of those three are under way.




**UTRAC PRIORITIZED PROJECTS:
GROUP 4 – HYD, ENVIRO,
ROADWAY**

- ✓ 04-6: Design Methods for Unique Culvert Installations
 - Project Cancelled – NCHRP Study Underway
- ✓ 04-2: Bridge Scour Countermeasures, Ph II
 - Project Underway
 - Dr. Alan Zundel, BYU
- ✓ 04-1: Context Sensitive Visual Resource Assessment & Management (VRAM) System
 - Project On Hold – Planned for early '06

RESEARCH PROJECT STATUS

Last year, Group 4 was Hydraulics, Environmental and Roadway design. These three projects were prioritized by that group.




**UTRAC PRIORITIZED PROJECTS:
GROUP 4 – HYD, ENVIRO,
ROADWAY**

- ✓ AM-002: Evaluation of Rapid Mapper Technology
 - Project Complete (Utilities & Right of Way)
 - Jesse Anderson, Carter Burgess

RESEARCH PROJECT STATUS

This project is also related to the Roadway design segment of Group 4. It didn't come through UTRAC, though. It was an opportunity that materialized after the workshop, and the administration decided that we should fund it.



**UTAC PRIORITIZED PROJECTS:
GROUP 5 – PLANNING AND ASSET
MANAGEMENT**

- ✓ 05-7: Extract Vehicle Classification from TOC Video
 - Project Underway
 - Dr. H. Cheng, USU
- ✓ 05-3: Access Management Performance Index
 - Project On Hold – inadequate funding
- ✓ 05-11: Determination of Crash Costs for Use in Benefit/Cost Analysis (Value of Life)
 - Project Underway
 - Dr. Joe Perrin, UofU

RESEARCH PROJECT STATUS

In the Planning and Asset Management group, four projects were prioritized. These are the first three.




**UTAC PRIORITIZED PROJECTS:
GROUP 5 – PLANNING AND ASSET
MANAGEMENT**

- ✓ 05-10: Good Roads Cost Less
 - Project Scope Being Revised

RESEARCH PROJECT STATUS

This is the fourth project from the Planning and Asset Management group.




**UTAC PRIORITIZED PROJECTS:
GROUP 6 – ITS / TRAFFIC & SFTY**

- ✓ 06-6: Advanced Warning Signal Site Selection Evaluation Matrix
 - Project On Hold – Pending completion of first phase project
 - Dr. Grant Shultz, BYU
- ✓ 06-7: Access Management / Traffic Impact Analysis
 - Project On Hold

RESEARCH PROJECT STATUS

Group 6 was ITS / Traffic and Safety. These are the two projects from that group. As you can see, both of these are on hold while other work is being completed, or to work out scope details. These will be funded once those other tasks are done.




UTRAC PRIORITIZED PROJECTS: GROUP 7 – GEOTECHNICAL

- ✓ 07-3: Dynamic Passive Pressure on Abutments & Pile Caps
 - Project Organizing as Pooled Fund Project
 - Dr. Kyle Rollins, BYU
- ✓ 07-2: Programming of Strong Ground Motion Instrumentation of New Bridges
 - Contract Pending
 - Dr. Marv Halling, USU (with Dr. Bartlett, UofU)
- ✓ 07-6: Geophysical Methods to Prioritize Mitigation Options for Coal Hill Landslide
 - Project Underway
 - Francis Ashland, USGS

RESEARCH PROJECT STATUS

Three geotechnical projects were listed for funding. One of these, the third one, is in Southern Utah, in Region 4.



UTRAC PRIORITIZED PROJECTS: GROUP 8– STRUCTURES

- ✓ 08-1: Improvement of Deck Concrete Mix Design and Curing Practices
 - Project Underway
 - Dr. Paul Barr, USU
- ✓ AM-001: Evaluation of Effects of Stay-in-Place Forms on Bridges
 - Project Underway
 - Dr. Spencer Guthrie, BYU

RESEARCH PROJECT STATUS

These two structures projects were prioritized, and are underway.

If you are curious about the details of any of these projects, we can provide you more information about any of them. Contact one of us in the Research Division to get that information.




UTRAC PRIORITIZED PROJECTS

- ✓ Prioritized List:
 - 25 projects
 - \$ 1,180,500 needed
- ✓ Funded to Date:
 - 17 projects authorized
 - \$ 862,100 committed

RESEARCH PROJECT STATUS

Those 25 projects required about \$1.1 million of research funding. At the time that I put this list together, we had funded 17 of those 25 projects, totaling about \$862,000. As you noticed on these previous slides, some of these other projects are just waiting their turn to get funded. For various reasons, a few will not end up getting funded, but most of those 25 will. In time, as these projects are executed, we will get some products to you; products that you can use and improve the way you work. You may have noticed that one of the projects has already been completed.




RESEARCH FUNDING SOURCES

- ✓ State Planning & Research (SPR)
- ✓ State Research Funds
- ✓ Pooled-Fund Projects
- ✓ Special Appropriations (I-15 Testbed, etc)
- ✓ Special Programs (Innovative Bridge, etc)

RESEARCH PROJECT STATUS

Our research funding comes from a variety of sources. Most of the UTRAC projects are funded from those first two, State Planning and Research funds, which are Federal dollars that come to the Department, partly to Research and partly to the Planning Division, and, State Research funds. We have some other sources as well, where we combine resources with other states, and special appropriations. These special appropriations are usually Federal funding sources.




TOTAL RESEARCH PROGRAM

- ✓ Research Projects Underway:
 - 65 projects
 - \$ 5,524,100 under contract
 - Total doesn't include:
 - 19 Experimental Features Projects (In House)
 - 15 Pooled Fund Projects (Other States are Lead)
 - NCHRP Program
 - TRB Program
 - TIG Program
 - WASHTO-X Technology Transfer Program

RESEARCH PROJECT STATUS

Currently, the Research Division has 65 projects underway. They are either UTRAC projects or they are special projects. Some of these are several years old and have long durations. Currently we are running about \$5.5 million dollars of research projects in some stage of the game. Some of these are in implementation, some of these are just getting under contract. And these are just the research projects. They don't include the Experimental Features projects. There are a lot of those, they are smaller and faster, usually. They also don't include Pooled Fund projects that other states manage. The projects we manage fit into this list here.



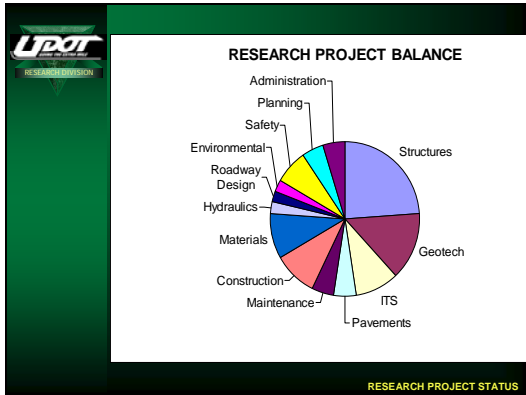
RESEARCH PROGRAM BALANCE

Active Projects- Funded with SPR, State, I-15 Testbed, Innovative Bridge, Pooled-Fund and others

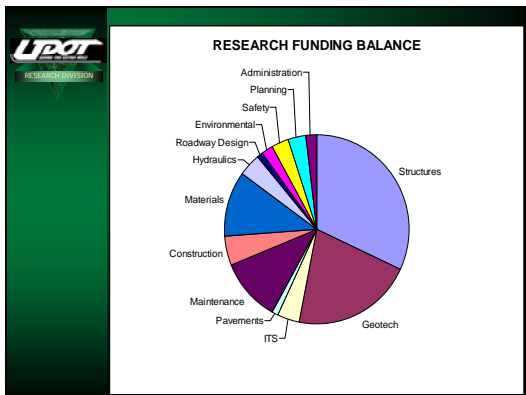
	Projects	% Funding
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RESEARCH PROJECT STATUS

We have made an attempt to look at what categories these projects fit in. Some projects are multi-disciplinary, but this list summarizes the areas these current projects are in.



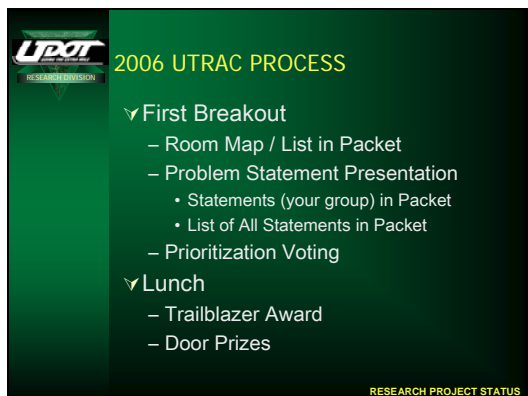
This is a graphic representation of that same data. Sometimes the innovative bridge funds, and other things, are fairly large projects and that skews the numbers a little bit, but this gives a graphic idea of our research balance by topic area. For those of you interested in topics shown here that have smaller slices of the pie, maybe you will be inspired today and come up with some good, successful projects that can be put into the mix and help you out.



If you look at this distribution from a dollar standpoint, the pie is similar, but some of the pieces are a little larger. Again, some of the projects have a tendency to have a larger dollar value than others. So, this is a graphic representation of the how the process works and how our efforts are distributed.



In the past we had these eight practice groups in the UTRAC workshop. Two years ago we had only five, so we keep expanding to try to focus our efforts a little bit and try to serve more of the discipline groups inside of UDOT. So, last year we expanded into these eight practice groups.



We made a slight modification this year and went to nine groups. These are the nine groups, with Hydraulics being the latest addition. Each of you, when you registered, were invited to, or RSVP'd to a particular group. The binder, or folder, you received this morning indicates the group that you are in, as does your name tag. So that is the group that you are assigned to. Again if you have certain projects in other groups that you are interested in, feel free to join those groups and move around and provide your input wherever it is most useful.

In a few minutes, after we leave this session, we will take a quick break and then we will move into our first breakout session. Inside your packet, there is an agenda and a map that shows the room assignments. There is also a list of the nine groups that I just showed you, indicating the group leader and the research contact for each group and the room number assigned. All but one of the groups are meeting upstairs in the building east of the registration area.

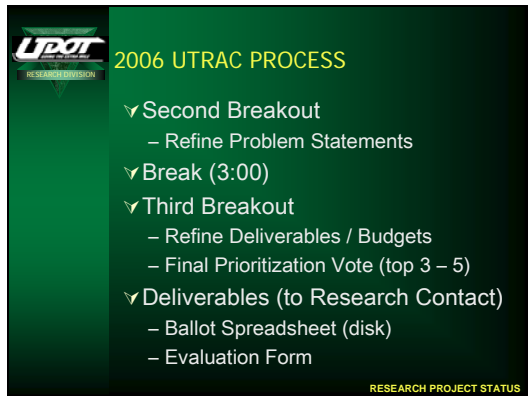
In the first hour and a half in that breakout group, the concept is to review each of the Problem Statements assigned to your group. In your packet, you have a copy of all those Problem Statements. Your group leader has a copy of all 60 problem statements for all groups. So, if you are interested in looking at what the other groups are doing, your Group Leader and Research Contact have copies of all of those.

So, during this first breakout session, go through each of your Problem Statements and talk about them. If the person is there that prepared the Statement, hopefully that is the case, they can present the Problem Statement, talk about the goals, what they are going to achieve, what kind of problem they are trying to solve, how it will be implemented, etc.

At the end of the first session, you will go through a voting process to eliminate some of the Statements. Your Group Leader has ballots and a tally spreadsheet on a disk for this purpose. Some of the groups have ten or twelve Problem Statements. So, the goal is to eliminate a third or half of those, where ever the

natural voting break is. Then you can come back in the afternoon and focus on those a little more.

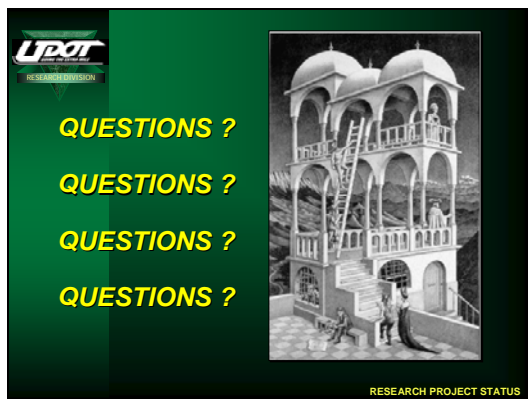
We will meet back here at 11:45 for lunch, and the presentation of the Trailblazer award. We will also have some door prizes, selected and presented by Barry Sharp.



After lunch, we will have a second breakout session where we will focus on the prioritized Problem Statements. Look real close at the budgets, to determine whether there is adequate budget to meet the needs described on the task list. Is the task list complete? Do you have the right things to work on to solve the problem. And then, when you are done, have the proper implementable items been listed? Do you have the right people on the list to help guide the project so when we are done we can put the results to good use? Those are the kinds of things to focus on in the second breakout.

We will then have another break.

In the third breakout, you will do a little more refining of the budget and deliverables, and then have a final prioritization vote. You will report back to us the top three to five Problems from your group.



Everyone has a one-page evaluation form in their packet. Turn those in before you leave, since we use those to evaluate this process and make changes. A lot of the changes we made last year were a direct result of the feedback we got on those forms.

This is a good time for me to thank all those that helped me put all this together.

Esther Olsen took a lead in helping me organize the workshop, and RaeAnn Jensen, Raeleen Sanchez, and Jen Crane helped with the physical preparations, with posters, and the packets. Barry Sharp and Debbie Heim arranged for the door prizes. I want to thank Mumtaz, our new librarian, and our official camera guy today.

Do you have any questions about this process or what we are about to do?

I sure appreciate all of you coming out and supporting us in this workshop. It is important that we understand what your needs are and get a good handle on those so we can do the right things for all of you in the next year or two. We hope everyone is enthusiastic about this and can really focus and get some work done today.

With that, we will move on to our first break.

RESEARCH PROBLEM STATEMENTS

Each issue considered during the UTRAC workshop is described in a “UTRAC Problem Statement” form. The statements are prepared and submitted prior to the workshop. The form includes the objective of the proposed research, the steps anticipated to meet the objective, the approximate budget needed to perform these steps, the deliverables desired, the challenges and hurdles anticipated during the work, the key champion within UDOT who will monitor and use the results of the work, and other individuals and organizations are interested in the research efforts.

Problem Statements Prioritized For Funding

During the UTRAC Workshop, each discipline group discussed and prioritized the Problem Statements submitted to their group. The three to six highest priority Problem Statements, in order, were submitted to the Research Division for potential funding. The complete list of Problem Statement considered by each group is shown in the next section of this report, along with the priorities assigned to them. After matching the available fiscal year 2007 research funding (from federal State Planning and Research [SPR] funds and state Construction funds) with the list of priorities, a list of 19 Problem Statements resulted.

The 19 Problem Statements ranked for funding are shown below, including the funding priority, the Problem Statement number and title, the discipline area each falls within, and the approximate budget anticipated. The research funding allocated to these projects is \$1,041,200.

Following this list, the full text of each Problem Statement is given, in order of funding priority.

<u>Funding Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Discipline</u>	<u>Approx Budget</u>
1	06.01-2	Quality and Safety During Nighttime Construction Activities	Construction	\$10,000
2	06.02-6	Pavement Distress in 9.5mm vs 12.5 Asphalt on Thin Overlays	Maintenance	\$35,000
3	06.03-6	Validate Hamburg Wheel Tracker using Field Tested Superpave Mixes	Materials & Pavements	\$60,000
4	06.04-4	Development of an indirect wildlife impact methodology	Environmental	\$96,000
5	06.05-6	Seismic Vulnerability and Emergency Response of UDOT Lifelines	Planning & Asset Mngmnt	\$90,000
6	06.06-3	A Safety Analysis of Fatigue and Drowsy Driving	Traffic Mngmnt & Safety	\$39,500
7	06.07-6	Stone Column Treatment with Wick Drains in Silty Sands	Geotechnical	\$30,000

8	06.08-1	Evaluation of Bridges for Seismic Retrofit	Structural	\$120,000
9	06.09-1	Fish Passage at Utah Culverts: Strategy, Assessment, and Design (also ranked #2 by Environmental Group)	Hydraulics	\$74,000
10	06.07-3	Assessment of mud balance test for Quality Assurance in Ground Anchor Installation (also ranked #6 by Materials Group)	Geotechnical	\$4,000
11	06.01-3	GIS Project Tracking Website	Construction	\$95,000
12	06.06-2	Evaluation of the Safety and Design Integrity of Two-Lane Rural Highways Using the Interactive Highway Safety Design Model (IHSDM) Developed by FHWA	Traffic Mngmnt & Safety	\$47,700
13	06.03-2	Asset Improvement Tracking – (construction history) (also ranked #3 by Planning Group)	Materials & Pavements	\$30,000
14	06.02-1	Install Avalanche Monitoring System	Maintenance	\$100,000
15	06.07-10	Development of MSE Wall Inspection Plan Based on Failure Mode Analysis and Risk Assessment	Geotechnical	\$40,000
16	06.07-5	Improved Performance of MSE Walls	Geotechnical	\$25,000
17	06.09-2	Estimating Peak Flow Statistics for Ungaged Streams in Utah-Development of Regional Flow Characteristic Regression Models and web-based, GIS Model User Interface	Hydraulics	\$35,000
18	06.05-7	Calibration and Validation of I-15 VISSIM model	Planning & Asset Mngmnt	\$30,000
19	06.08-2	Calibration of AASHTOs New Prestress Loss Design Equations	Structural	\$80,000

2006 RESEARCH PROBLEM STATEMENT

Problem Title:

Quality and Safety During Nighttime Construction Activities

No.: 06.01-2

Submitted By:

Rob Wight

E-mail: rwight@utah.gov**1. Briefly describe the problem to be addressed:**

Over the past years UDOT has looked to do more and more road construction during the night to inconvenience the traveling public as little as possible. While this trend will likely continue, what are the implications to quality, productivity, worker safety, and public safety?

Develop a set of guidelines for the Department – include a checklist of when it is or is not appropriate to use night work for specific activities. Identify ways to incorporate checklist items into the design process (scoping, planning, preconstruction, etc.)

Look at more of the construction activities and determine the actual constructability issues (tack coat visibility, saw cutting of concrete, limitations of operations affects, lighting, etc.) Consider outlining guidelines for specific types of construction projects.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Literature Search: State of the Art – What are other states doing?
2. Identify the impacts on quality, productivity, worker safety and public safety.
3. Identify effective performance measures.

3. List the major tasks required to accomplish the research objective(s):**Estimated person-hours**

1. Literature Search

Hold a TAC meeting following literature search where findings are summarized.

2. Prepare draft document for review.

Include recommendations for policy, specifications (list requirements for Contractor), summary of national findings related to quality, productivity, worker safety, public safety, construction costs, user costs, etc.

Outline of a checklist that ties activities to the design process.

Provide guidelines indicating how to approach nighttime construction activities.

3. Solicit input/comments from TAC.

4. Prepare final document.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Start date: July 1, 2006

Literature Search Completed by: August 30, 2006

Draft Document Outlined by: October 1, 2006

Revisions/Comments: November 1, 2006

Final Document: January 15, 2007

Library Sessions by February 30, 2007

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT In House Study

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Technique, training, report, manual of practice

8. Describe how this project will be implemented at UDOT.

It will impact future decisions to allow or modify construction work during nighttime hours with respect to safety and quality issues.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from the implementation of this project through better decision making relating to nighttime construction activities.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Rob Wight

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): In House

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) REs,		
B) Preconstruction		
C) Local Govts	Consider outlining an agreement that would be formed on a project by project basis with the cities.	
D) Safety		
E) OSHA (coordinate with)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Pavement Distress in 9.5mm Asphalt vs 12.5mm Asphalt on thin overlays

No.:06.02-06

Submitted By: Lloyd Neeley / Norton Thurgood

E-mail: lneeley@utah.gov
nthurgood@utah.gov

1. Briefly describe the problem to be addressed:

Our field experience suggests that our 3/8" asphalt with high grade AC10 oil is holding up better under heavy truck loading than 1/2" asphalt with 64-34 PG oil, when placed at 1.5 inches to 2 inches. Both asphalts have been placed on I-84 in Western Box Elder County at 1.5-2 inches and the 3/8" had less rutting and shoving after 1-3 years.

Strategic Goal: ☒ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Can these findings be duplicated?
2. Should we be using strictly 3/8" with high-grade AC10 for thin overlay, including betterments?
- 3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|--|----------|
| 1. Mill selected section for constant starting condition via contract | \$20,000 |
| 2. Fund testing and analysis to evaluate existing condition | 40 |
| 3. Pave in consecutive sections using both asphalts in different areas (Region 1 budget) | 0 |
| 4. Monitor sections for distress (UDOT Research and Region 1 Pavement Engineer) | 100 |
| 5. Write Report | 20 |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Mill and Pave sections in summer of 2006. Record distress 3 times in 2007 and 3 times in 2008.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT Region 1 w/ support from UDOT Research

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Performance comparison report of the two oil – aggregate size combinations.

8. Describe how will this project be implemented at UDOT.

Barry Sharp and Wayne Felix will create work plan.

Wayne Felix and Norton Thurgood will coordinate initial evaluation and construction.

Wayne Felix and Barry Sharp will analyze distress data and create report.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Initial comparison which can lead to better decisions and perhaps set the stage a more advanced analysis in the future, since this will compare combinations and not specific components.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Norton Thurgood

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Wayne Felix	Region One Pavement Engineer	801-620-1608	Yes
B) Brent Stokes	Region One Station Supervisor	435-2794327	Yes
C) Kevin Griffin	Region One Operations	801-620-1600	Yes
D) Spencer Guthrie	Brigham Young University / Civil Engineering	801-422-3864	Yes
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

LeGrand Johnson Company

Jack B. Parson Companies

UDOT Central Materials

UDOT Central Maintenance

RESEARCH PROBLEM STATEMENT

Problem Title:

Validate Hamburg Wheel Tracker using Field Tested Superpave Mixes

No.: 06.3-6

Submitted By:

Kevin VanFrank

E-mail: kvanfrank@utah.gov

1. Briefly describe the problem to be addressed:

The question is, do Hamburg Wheel Tracking Device (HWTd) testing results represent field performance of a mix? A number of Superpave mixes have been built over the last ten years. Their field performance and mix design has been cataloged in a previous UTRAC study. Valadation of HWTd procedures and test methods is available by reproducing these Superpave mixes in the laboratory and documenting their performance under HWTd testing.

Strategic Goal:

☒ Preservation

☐ Operation

☐ Capacity

☐ Safety

(Check all that apply)

2. List the research objective(s) to be accomplished:

1. Forensically reproduce superpave mix designs used in UDOT projects.
2. Subject the mixes to the current HWTd test methods.
3. Develop bracketing tests using temperature and loading variables.
4. Analyze correlations between HWTd test results and field performance.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. From previous research, Identify candidate pavements and mix designs.
2. Categorize pavement performance into reliable, moderately reliable and unreliable pavements.
3. Identify loading conditions on candidate pavements.
4. Obtain current UDOT HWTd test protocols. Identify bracketing procedures using temperature and loading variables
5. Reproduce the mix designs and test them under the above procedures.
 - First stage – use single lab
 - Second stage – incorporate multiple labs
6. Evaluate the results.
7. Propose test protocol for major binder grades, recycled asphalt (RAP) content and loadings.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Would like to see this begin during (2006) construction season with results by March 2008.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant-University-UDOT Combination

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Interim reports to indicate current experience and best to date assumptions.
2. Final report to summarize data and provide proposed test procedures for binder grade, RAP content and loading.
 - a. Focus on long-term projections
 - b. Include more than pass-fail judgements on predictions
3. Develop precision criteria
4. Identify possible variations to current 10 mm acceptance criteria

8. Describe how will this project be implemented at UDOT.

The test methods and limits would be incorporated into HWTED test protocols and into mix verification requirements/specifications. Consider for use in dispute resolutions,

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By assuring that the HWTED testing results reflect field performance, UDOT will obtain pavements that are applicable to their service conditions. Reliable test results will give the department confidence that it is spending the appropriate amount of money to get the results it is planning for.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Minimal number of entities with a HWTED. U of U has one.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Kevin VanFrank UDOT Engineer for Asphalt Materials (801) 965-4426

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$60,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Tim Biel	UDOT Central Materials	965-4859	y
B) Kevin VanFrank	UDOT Central Materials	965-4423	
C) Mark White	UDOT Central Materials	965-4295	
D) Stephan Charmont	Sem Materials		
E) Doyt Bolling	Utah LTAP		
F) Jim Cox	UDOT Region Three Materials Engineer – U of U Student		
G) Pedro Romero	U of U		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Possible FHWA Pooled Fund Topic

2006 RESEARCH PROBLEM STATEMENT

Problem Title:

Development of an indirect wildlife impact methodology

No.: 06.04-04

Submitted By:

Tom Twedt, BIO-WEST; and Greg Punske, FHWA

E-mail: ttwedt@bio-west.com

Gregory.punske@fhwa.dot.gov

1. Briefly describe the problem to be addressed:

The indirect impacts on wildlife (primarily noise) on constructing and operating highways in Utah and nationwide are not well understood, but are of concern to resource agencies ever more frequently. The agencies are obligated to evaluate these impacts, but have no available methodologies or “tools” to use, thus they tend to “guesstimate” (probably overestimating) the impacts. A reliable method that can be replicated and readily applied is needed to facilitate the environmental review process and make it more efficient and accurate.

Strategic Goal: ☒ **Preservation** ☒ **Operation** ☐ **Capacity** ☐ **Safety**

(Check all that apply)

2. List the research objective(s) to be accomplished:

1. Evaluate existing state and federal approaches to indirect wildlife impact assessment
2. Develop a practical and feasible assessment methodology for Utah agencies.
3. Make methodology available for use.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|-----|
| 1. Coordinate agency involvement and support | 80 |
| 2. Determine and evaluate current approaches | 160 |
| 3. Assess preliminary Legacy Parkway indirect avian impacts | 240 |
| 4. Formulate assessment methodology | 320 |
| 5. Coordinate with agencies and refine as appropriate | 120 |
| 6. Develop guidance manual and distribute | 280 |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Total Time = 2 years

Complete Tasks 1 and 2 first summer (2006)

Complete Task 3 following fall and winter (2006-2007)

Complete Task 4 next spring (2007)

Refine with 2007 Legacy data during fall /winter (2007/2008)

Complete Task 5 winter (2008)

Complete Task 6 spring (2008)

5. Indicate type of research and / or development project this is:

Large: ☒ **Research Project** ☐ **Development Project**

Small: ☐ **Research Evaluation** ☐ **Experimental Feature** ☐ **New Product Evaluation** ☐ **Tech Transfer Initiative :**

☐ **Other**

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant or University with highway impact assessment experience. Resource agency collaboration and oversight is available and desirable.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A technical report and a procedural manual which will be usable by UDOT specialists, agencies and consultants.

8. Describe how will this project be implemented at UDOT.

Upon approval, incorporate methodology into UDOT Environmental Process. Encourage use by resource agencies and consultants on appropriate new projects.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Implementation will provide an acceptable method of accessing (and thus mitigating) indirect impacts to wildlife farm transportation projects. The results will benefit UDOT, Resources agencies, and the resource itself.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No risks anticipated other than the challenge of applicability to wide range of ecosystems without extending testing and evaluations.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Shane Marshall – Environmental Program Manager – (801) 965-4384

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

\$96,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Brent Jensen	UDOT Envir/Hydraulics/Geotech Mgr.	801-965-4327
B) Paul West	UDOT Wildlife Specialist	801-965-4672
C) Tom Twedt	BIO-WEST, Inc.	435-752-4202
D) Greg Punske	FHWA Environmental Lead	801-963-0078 ext. 237
E) Adam Kozlowski	DWR Region 1	801-476-2740
F) Nathan Darnell	USFWS Ecological Services	801-975-3330 ext. 137

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah Division of Wildlife Resources
US Fish and Wildlife Service
Federal Highway Administration
US Army Corps of Engineers
Transportation Research Board

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Seismic Vulnerability and Emergency Response of UDOT Lifelines

No.: 06-05-6

Submitted By: Steven Bartlett, Peter Martin, Steve Burian

E-mail: bartlett@civil.utah.edu

1. Briefly describe the problem to be addressed:

Earthquakes pose a significant risk to UDOT's transportation infrastructure. This infrastructure is needed after a seismic event to provide emergency response, recovery and reconstruction functions. It is important that the transportation network perform these vital functions in a timely manner to reduce loss of life, property and commerce following a major earthquake.

This study proposes to focus on two key aspects: 1) seismic vulnerability of the transportation system and 2) emergency response. Risk assessment, traffic modeling and loss estimation techniques will be applied to the transportation network to determine vulnerability of the system and lifelines that most be protected, maintained or upgraded to perform emergency response and recovery functions. The results of vulnerability study will also be used to develop emergency response strategies/activities to aid in pre and post-event planning.

The study will first start in Salt Lake County and then later encompass the Urban Wasatch Front.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Assess the seismic vulnerability of UDOT infrastructure using a systems approach.
2. Identify and prioritize UDOT's lifeline corridors and facilities using a risk based approach
3. Help UDOT develop a plan/program to protect/maintain/improve critical lifeline corridors
4. Help UDOT develop emergency response strategies/activities to enhance emergency response and recovery.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours: 2000 to 3000

1. Apply the FHWA seismic risk assessment model to Salt Lake Valley to estimate potential earthquake damage resulting from earthquake strong motion, liquefaction, fault rupture, earthquake-induced landslides and mass movement.
2. Use UDOT traffic models to assess the disruption to the system from earthquake damage: including user and economic losses and delays results from the damage.
3. Determine the losses for a scenario earthquake (rupture of the Salt Lake City segment of the Wasatch fault) and other nearby events using risk assessment.
4. Identify key corridors and facilities that should be targeted from improvement, upgrade, or replacement.
5. Help UDOT develop emergency response activities that minimize the disruption and restore the system to a serviceable capacity and added these activities to the emergency response plan.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

One year proposed schedule for completion of Salt Lake County

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University of Utah Civil and Environmental Dept. and the U of U Traffic Lab

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Technical summary report
2. ARC GIS hazard assess,emt and traffic models
3. Implementation/Emergency Response plan for planning, traffic operations and safety.

8. Describe how this project will be implemented at UDOT.

1. Results of the study can be used for future planning and maintenance activities and funding of these activities
2. Traffic model can be used for other types of assessment (spills, floods, landslides, etc.)
3. Modifications/adaptations to UDOT's emergency response plan and activities

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

1. Reduction in seismic vulnerability and risk
2. A well-planned assessment and emergency response plan that includes realistic earthquake scenarios, damage and response to that damage.
3. Identification of key lifeline corridors and strategies to maintain, improve or upgrade these corridors.
4. A risk assessment/cost-benefit model that can be used for maintenance and planning purposes

10. Describe the expected risks, obstacles, and strategies to overcome these.

None. The proposed methods have already been developed by FHWA and the national center for earthquake engineering research. Traffic models have already been developed for the study area. This project will combine these models to develop the study and emergency response activities.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Richard Clarke, Division of Maintenance
Walter Steinvorth, Division of Planning
Shana Lindsey, Division of Research

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20k to \$30k

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Bob Carey	DPE-DES	538-3784
B) Barry Welliever	Utah Seismic Safety Commission	barrywelliever2@earthlink.net
C) Gary Christenson	Utah Geologic Survey	537-3304

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

MPC

(THE MPC WILL BRING MATCHING MONEY (DOLLAR PER DOLLAR) FOR THIS STUDY.)

2006 RESEARCH PROBLEM STATEMENT

Problem Title: A Safety Analysis of Fatigue and Drowsy Driving

No.: 06.06-3

Submitted By: Peter Tang (UDOT) and Grant Schultz (BYU)

E-mail: ptang@utah.gov, gschultz@byu.edu

1. Briefly describe the problem to be addressed:

On average, at least 10 percent of all fatal crashes in Utah have been identified as fatigue-related. Driver fatigue, however, is difficult for officers to assess; hence fatigue-related crashes are likely under-reported and may be contributing to significantly more crashes than statistics show.

UDOT has recognized the seriousness of fatigue and drowsy driving and has taken a number of measures to reduce fatigue related crashes. One of the primary measures was the creation and installation of fatigue warning signs at several locations on I-80 between Tooele and Wendover beginning in November 2004. The 2005 crash data shows a reduction in crash numbers related to drowsy driving, presumably as a result of these signs. In addition, a task force comprised of UHP, UDOT, Utah Highway Safety Office, and a private company was formed in 2005 to promote awareness through various media avenues.

The purpose of this research is to develop a strategy to mitigate fatigue-related crashes statewide. First, to identify locations where fatigue is a primary causal factor for crashes in roadway segments. Second, to evaluate the effectiveness of current mitigation measures including the interstate fatigue warning signs and the educational campaign related to fatigue and drowsy driving. Third, to identify other mitigation measures for fatigued driving. Fourth, to provide recommendations for mitigation at locations in step 1 using the identified measures.

Strategic Goal: ☐ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Utilization of the GIS enabled web delivered data almanac and the C.A.R.S. data system to identify high crash locations where fatigue and drowsy driving may be the significant causes.
2. Evaluate the effectiveness of the mitigation efforts to date by UDOT related to fatigue and drowsy driving.
3. Propose and evaluate possible engineering solutions to mitigate the concerns at the identified locations. Solution could include additional signage, rumble strips, rest stops, and so forth.
4. Make recommendations for mitigation measures at identified locations.

3. List the major tasks required to accomplish the research objective(s): 18 months Estimated person-hours 1,750

1. Perform an in depth analysis of crash data from the C.A.R.S. data system and the GIS crash data almanac to identify fatigue and drowsy driving high crash locations on all major state routes.
2. Solicit input from emergency service personnel, UHP, and other local law enforcement personnel to verify high crash locations identified and to pinpoint additional locations.
3. Evaluate the effectiveness of the fatigue warning signs on I-80 through an analysis of crash data before and after installation combined with a survey of motorists along this stretch between Tooele and Wendover.
4. Perform literature review on the mitigation techniques available to reduce fatigue and drowsy driving.
5. Evaluate the effectiveness of the median/education campaign efforts.
6. Perform on-site visits to evaluate conditions and identify engineering mitigation efforts at each site.
7. Provide final recommendations and conclusions on both the effectiveness of current installations and future strategies.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is recommended that this project begin in Fall 2006 with the initial tasks of the literature review and evaluation of effectiveness. Once the effectiveness is determined, additional sites can be identified and on-site visits performed in the summer 2007. Results would then be tabulated in the Fall 2007 and recommendations made.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☒ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation with input from focus groups comprised of UHP and local participants.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project includes a report documenting the high crash locations for fatigued driving, as well as recommendations of mitigations for those locations. Also included will be an evaluation of current mitigation measures and documentation of the literature review and survey results. The report will serve as the basis of UDOT's strategy to mitigate fatigue-related crashes statewide.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT through the Traffic & Safety program. Funding for recommended mitigation measures is available through multiple sources including the Roadway Safety Improvement Programs, the Safety Spot Improvement Program, the UDOT Signing Program, and other funding sources available to local governments. The result of this research will be extremely useful for the Department to focus available resources on reducing fatigue-related crashes.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from this project by implementing engineering mitigation measures at those high crash locations identified to reduce crashes caused by fatigue and drowsy driving. The documented results will also be useful in aiding the Department in understanding how to best apply the signage and education efforts in the future. The ultimate goal for the project, however, is to communicate the results to law enforcement and the general public in an effort to SAVE LIVES!

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Peter Tang, Traffic & Safety (801) 965-4285

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$39,500

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Grant Schultz	Brigham Young University	(801) 422-6332
B) Rob Clayton	UDOT Traffic & Safety	(801) 965-4521
C) Robert Hull	UDOT Traffic & Safety	(801) 965-4273
D) TBD	UHP	
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah Highway Patrol, Utah Highway Safety Office, NCHRP, TRB, ITE, City and County

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Stone Column Treatment with Wick Drains in Silty Sands

No.: 06.07-6

Submitted By: Kyle Rollins

E-mail: rollinsk@byu.edu

1. Briefly describe the problem to be addressed:

Conventional wisdom indicates that stone column treatment is not effective when fines contents exceed 20%. Nevertheless, many potentially liquefiable soil profiles have fines contents greater than 20% and must be mitigated in some way. Recent experience suggests that wick drains may facilitate drainage and allow improvement with stone columns for these soils; however, procedures for quantifying the degree of improvement and desirable drain spacing are poorly developed. In addition, some case histories have shown that wick drains may not always guarantee success. No guidelines are currently available to indicate conditions when drains might be ineffective. A critical evaluation of available case histories and relevant results from lab testing and computer analyses is needed. This study should define conditions where drains will or will not improve stone column efficiency and quantify the degree of improvement that might be expected. Recommendations from this study will be particularly useful for upcoming design projects where stone column mitigation of liquefaction hazard will likely be necessary.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop curves to predict final blow count as function of initial blow count and column spacing for silty sands with and without drains
2. Identify conditions which will limit the effectiveness of stone column treatment with wicks
3. Develop recommendations regarding design of stone columns in silty sands

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Collect case histories involving stone column treatment of silty sand with and without wick drains.
2. Collect field data if cooperation and coordination can be obtained with UDOT project contractor.
2. Perform statistical analysis to evaluate improvement relative to fines content, initial blow count, drain spacing, etc.
3. Develop design curves identifying improvement with and without drains
4. Identify factors which significantly inhibit improvement and effectiveness of drains.
5. Develop design recommendations regarding use of stone columns treatment in silty sands
6. Prepare final report.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project will be carried out over a one-year period. Geotechnical specialty contractors will be contacted for information. Hayward-Baker has already agreed to provide data from five projects involving use of wick drains with silty sands. Information from other contractors and government agencies (USBR) will be solicited. Collect field data if cooperation and coordination can be obtained with UDOT project contractor (schedule to be determined). Data collection and synthesis should take about 3 months. Analysis and development of recommendations will occupy another 6 months and the final recommendations and report will be completed in the last 3 months.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University research team working in collaboration with the UDOT geotechnical group

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report which provides curves for predicting improvement based on soil properties and column spacing along with recommendations detailing when drains are likely to be effective or ineffective.

8. Describe how will this project be implemented at UDOT.

Workshop on report and recommendations will be provided to UDOT engineers and consultants. The design curves and recommendations can also be included in UDOT geotechnical design manual. These results will be a significant aid to engineers working on liquefaction hazard mitigation for upcoming road projects.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Stone column treatment using wick drains has the potential for making liquefaction hazard mitigation possible for sites with high fines contents where conventional methods would be ineffective or extremely expensive. These cost savings would reduce UDOT design and construction costs.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Limited test results may make it difficult to draw firm conclusions. Some additional soil testing may be necessary at some of the sites.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Jon Bischoff and Darin Sjoblom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$30,000 (additional cost associated with field data collection to be determined).

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Brad Price	RBG Engineering, Provo, Utah	374-5771
B) Jim Higbee	UDOT/Geotechnical Group/Complex	965-4351
C) Roberto Lopez	Hayward Baker, Santa Paula, California	925-825-5056
D) Mathew Francis	URS Consultants, Salt Lake City, Utah	808-551-8006
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Hayward-Baker, Inc., USGS, USBR.

2006 RESEARCH PROBLEM STATEMENT

Problem Title: **Evaluation of Bridges for Seismic Retrofit**

No.:06.08-01

Submitted By: Keri Ryan, Utah State University

E-mail: kryan@cc.usu.edu

1. Briefly describe the problem to be addressed:

UDOT plans to follow the lead of other state DOTs in identifying and updating or replacing bridges that are deficient in lateral resistance. A project is proposed to explore various retrofit techniques for different classes of bridges, and develop a procedure for future retrofit evaluation. Special emphasis is to be placed on seismic isolation as a retrofit technique. This often cost-effective approach can overcome many existing deficiencies in lateral resistance with minimal modification to the structural system, and can greatly extend the life of existing bridges. Seismic isolation has been extensively applied to bridges all over the U.S, with more than 175 total bridges and more than 40 percent in low to moderate seismic regions (Aiken et. al., 2006).

Strategic Goal: ☒ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop general guidelines for preliminary evaluation of bridges to predict the necessity of seismic retrofit and the most beneficial retrofit technique, to be used as a basis for further evaluation.
2. Develop a process for detailed retrofit evaluation of individual bridges, including use of software, modeling guidelines, and a decision-making flowchart.
3. Develop instructional material on bridge isolation systems, including representative designs for specific bridges in Utah.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Conduct a thorough literature review of seismic retrofit of bridges, including retrofit and modeling techniques. Look for correlation among bridge characteristics and retrofit techniques chosen. Interview state DOTs such as Caltrans and WSDOT for insight into evaluation procedures.
2. With UDOT staff and TAC, identify 8 existing bridges in Utah for detailed study and identify suitable general purpose finite element software for research and future evaluation.
3. Evaluate the seismic resistance of each of the 8 bridges in their existing state, and evaluate various retrofit alternatives considering both cost and performance. Retrofit techniques include strengthening of critical components, displacement enhancement (increasing seat width, column confinement), force limitation, soil improvement, and seismic isolation. In this task, a simplified capacity/demand procedure will be used wherein the force or displacement capacity of each element in the lateral load path is compared with the corresponding seismic demand.
4. Verify the results from Task 3 by detailed modeling and response history analysis with an appropriate suite of ground motions for a suitable selection of retrofit alternatives, including seismic isolation. Document the process carefully, and convert to procedural guidelines for detailed retrofit evaluation.
5. Based on Tasks 3 and 4, develop general guidelines for preliminary retrofit evaluation, to predict necessity of retrofit and most probable retrofit technique based on bridge characteristics. Incorporate simplified analysis of a larger set of bridges or a parameter study if information from Tasks 3 and 4 is insufficient.
6. Develop instructional material for UDOT engineers on the design of isolation systems, which include sample designs pertinent to the case studies in Tasks 3 and 4 documented in MathCad.
7. Prepare report and conduct training session for UDOT.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project duration is anticipated to be approximately 36 months, with the following breakdown of the above tasks:

Task 1 = 3 month	Task 4 = 12 month	Task 7 = 4 months
Task 2 = 1 month	Task 5 = 5 month	
Task 3 = 8 month	Task 6 = 3 month	

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University in association with UDOT staff and cost consultants

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables are (a) a report documenting the entire research effort, (b) guidelines for preliminary seismic retrofit evaluation in bridges, (c) instructional material and examples for the design of bridge isolation systems, and (d) a process or workflow for detailed seismic retrofit evaluation including decision making and modeling techniques.

8. Describe how will this project be implemented at UDOT.

This project will be implemented by an internal evaluation of the report, and integration of the proposed design standards into a policy manual, which governs how both UDOT engineers and consultants are required to approach retrofit evaluation and seismic isolation design. The research team will conduct a training program for UDOT engineers training program for UDOT engineers illustrating the retrofit evaluation process and modeling techniques with the selected software package. At the conclusion of this project, UDOT will consider proceeding with a demonstrative seismic isolation retrofit on one of the case study bridges.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from by incorporating consistent evaluation and state-of-the-art seismic retrofit techniques into a bridge retrofit program. State constituents will benefit from increased safety, extended life, and long term cost savings to existing bridges. If seismic isolation is implemented, enhanced performance is expected in a seismic event.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Structural systems and former construction practices for existing Utah bridges may be very diverse such that it is difficult to generalize techniques and outcomes from the case study bridges into a comprehensive evaluation program for all bridges. However, at the very least the project will be able to identify recurring classes of bridges that are at greatest risk and can benefit from a specific retrofit technique. UDOT needs to anticipate the funding needs for a long term retrofit program.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Boyd Wheeler

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

\$100,000 - \$120,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Boyd Wheeler	UDOT	
B) Marv Halling	USU	
C) Hugh Boyle	Consultant	
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA

2006 RESEARCH PROBLEM STATEMENT

Problem Title: **Fish Passage at Utah Culverts: Strategy, Assessment, and Design**

No.:06.09-1

Submitted By: Rollin H. Hotchkiss, Ph.D., P.E., D.WRE and Mark Belk, Ph.D., Brigham Young University

E-mail: rhh@byu.edu

1. Briefly describe the problem to be addressed:

There appears to be no Agency strategy or pilot database in place to guide assessment of aquatic organism passage, or even fish passage, at UDOT culverts, nor does there appear to be a design procedure in place for this objective. State Departments of Transportation are becoming more involved in providing passage for aquatic organisms (amphibians and fishes) at culverts in response to endangered species listings, other agencies' initiatives, and the desire to restore ecosystem connectivity to watercourses. UDOT is responsible for approximately 61,000 culverts, but aquatic organism and fish passage is currently addressed only on an as-needed basis, sometimes resulting in unanticipated consequences. For example, a recent culvert replacement project in Logan Canyon resulted in the elimination of all fish of interest upstream from the culvert because the design specification of using a corrugated metal pipe culvert was changed to a plastic pipe in the field. The smooth interior increased velocities so much that fish could not pass upstream. An assessment strategy and design procedure for aquatic organism or fish passage at UDOT culverts is needed.

2. List the research objective(s) to be accomplished:

1. Develop a strategy for prioritizing culverts for aquatic organism or fish passage
2. Determine an appropriate assessment protocol for Utah and test it in the field
3. Create a pilot database of assessment for UDOT to build upon based upon the results from Objective 2
4. Develop a design procedure that allows for aquatic organism or fish passage through culverts.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Meet with relevant Federal and State Resource agencies to strategize a culvert assessment prioritization scheme – **40 hours**
2. Using the prioritization scheme, identify the most urgent regions within the UDOT system for culvert assessment – **800 hours**
3. Review current assessment protocols and design procedures for potential implementation in Utah. Dr. Hotchkiss is compiling such protocols and procedures as part of a current FHWA-funded project on the design of bridges and culverts for fish passage – **80 hours**
4. Use the candidate protocol(s) on a representative sample of culverts and field verify assessment accuracy by performing fish counts – **1100 hrs**
5. Develop a GIS database of results and assessment outcomes – **500 hours**
6. Develop a draft procedure for the design of culverts for aquatic organism and/or fish passage – **280 hours**
7. Write a project report documenting results and recommending future actions; develop and provide training to UDOT personnel – **300 hrs**

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project will require 18 months. Tasks 1-3 will be completed within 5 months. The field campaign (Task 4) will take seven months and will require a summer sampling season to assure access to the selected culverts. Two months will be needed to develop the database and draft a design procedure (Tasks 5 and 6), and four months are allowed for review of the draft and final reports.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University in collaboration with UDOT and relevant agencies

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. A project report documenting all work
2. A GIS database of culvert assessments for use in the future and a draft design procedure for culvert design for aquatic organism or fish passage
3. Training for UDOT employees in use of assessment protocols, database construction, and culvert design

8. Describe how will this project be implemented at UDOT.

Task 4, performing field assessments, will be done with as much participation from UDOT personnel as their time and budget will allow. This will enable them to become familiar with the techniques that they can use in the future. Near the end of the project, a formal training program will be provided to all interested employees of UDOT and other agencies for culvert assessment and design. The pilot database of assessments will be maintained and grown as UDOT personnel continue the process of culvert assessment in the future.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT staff will have knowledge on how to continue the assessment program in the future. The culvert assessments can be used to prioritize fish and/or aquatic organism-friendly culvert replacements or retrofits. This strategy will save time and money. Other Federal and State Resource agencies can coordinate culvert replacements with UDOT, providing stream connectivity within a watershed that has multiple agency jurisdictions. The draft design procedure will provide UDOT hydraulic engineers a tool for specifying new culverts that will pass aquatic organisms and/or fish. Finally, the citizens of Utah will benefit from a long-term sustained fish and aquatic organism populations.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Potential Obstacle

- Interagency disagreement on priorities for assessment
- Extreme weather (flood or drought) that would make access to candidate culverts impossible

Overcoming the Potential Obstacle

- Meetings early and often in the project; interagency review of work
- Be prepared to re-align the field sampling program as needed

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Michael Fazio, Brent Jensen, and Denis Stuhff

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$74,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Tom Chart	Senior Fisheries Biologist, U.S. Fish and Wildlife Service	801-975-3330
B) Don Wiley	Fisheries Biologist, Utah Division of Wildlife Resources, Central Region	801-491-5678
C) Kris Buelow	JSRIP Local Recovery Program Coordinator, Central Utah Water Conservancy District	801 226-7132
D) Dan Duffield	Regional Fish Program Manager, U.S. Forest Service	801-625-5662
E)		
F)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

CUP Completion Office, Utah Department of Natural Resources Species Recovery Program, Utah Reclamation Mitigation and Conservation Commission, Federal Highway Administration

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Assessment of Mud Balance Test for Quality Assurance in Ground Anchor Installation **No.: 06.07-3**

Submitted By: Clifton Farnsworth

E-mail:
cliftonfarnsworth@utah.gov

1. Briefly describe the problem to be addressed:

In the Provo Canyon Reconstruction Project we are installing thousands of feet of ground anchors (ie soil nails and rock dowels). Our current specs require the contractor to take two cube samples per day and test them to verify the grout strength. This allows verification of the grout strength at 14 days and 28 days after installation as to whether the grout met strength. However, in the meantime the Contractor can be several rows lower and if there is a problem it is almost too late too fix it. The Post Tensioning Institute recommends using the mud balance test as a means of testing the grout strength upfront. The correlations between the specific gravity (which is measured with the mud balance) and compressive strength are very good for a grout comprised of only cement and water, which is what is being used as nail grout. Grout cubes are still taken periodically to ensure that the correlations are being met. We proposed at one point a while ago that this method be used on the Provo Canyon Reconstruction, but were rejected because UDOT is unfamiliar with the mud balance test. We propose to gather cube samples from the actual construction project, perform the mud balance on the same batch of grout, and gather a set of data from the field that show the correlations between the two.

2. List the research objective(s) to be accomplished:

1. Literature search on the specific gravity (mud balance) test.
2. Use the current construction as a means of gathering mud balance and grout cubes results to show the correlations between the two.
3. Recommendations for any adjustments that may need to be made to the soil nail / rock dowel specifications.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|--|
| 1. Literature search and review. | 10 hours |
| 2. Perform mud balance and make grout cubes. | Time Donated by Provo Canyon Team |
| 3. Break grout cubes. | Cost to Break Each Cube (5 hours per week) |
| 4. Compile correlation curves. | Time Donated by Provo Canyon Team |
| 5. Report and Recommendations for Spec Change | 20 hours |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The contractor is currently installing soil nails and rock dowels and will be throughout the summer. As soon as we can get things in place we can begin gathering data. They mix up many batches of grout throughout the day at several different locations on the project, so we can also test at various times of the day and in various locations along the project. We anticipate that the work will have to be done by the end of summer though as the soil nails / rock dowels will hopefully be completed.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
 Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT staff (Provo Canyon Team), possibly consultant performing the actual cube breaks.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The current specification is not a standard specification, but rather a special, since it is only used on a project here or there. However, recommendations as to how the spec can be modified allowing for better QA/QC.

8. Describe how will this project be implemented at UDOT.

Future projects that use soil nails and rock dowels may utilize the mud balance of a means of testing up front and verifying the strength immediately as opposed to having to wait the two to four weeks to make sure we are meeting the desired strength.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By using the mud balance with periodic cube sampling to verify the correlations, it is felt by the champions of this proposal that a better end product (soil nails and rock dowels) can be achieved. There is definitely the possibility to identify potential problems up front rather than waiting for the cube breaks.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The mud balance and cube sample construction take place in the field, right in the mix of the construction environment. This sometimes allows for error to creep into the data, as opposed to being done in a pristine lab environment. However, this can also be a good thing, as the numbers show what is really happening in a real life situation. Those performing the mud balance and cube samples will have to identify a uniform way of doing this to eliminate error.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Clifton Farnsworth and Jim Golden (Region 3 Construction)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$3000 - \$5000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Clifton Farnsworth	Region 3 Construction – Provo Canyon Crew	801-830-9314
B) Jim Golden	Region 3 Construction – Provo Canyon Crew	801-222-3436
C) Scott Andrus	Region 3 Construction	801-227-8029
D) Darin Sjoblom	UDOT Geotechnical Division	801-964-4474
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title:

GIS Project Tracking Website

No.: 06.01-3

(see also 06.05-11)

Submitted By: Ed Rock

E-mail: erock@utah.gov

1. Briefly describe the problem to be addressed:

One of the criticisms that UDOT receives from the public is why we don't have better coordination between our construction projects. Sometimes this happens because transportation funding is controlled by politics and we have little control over that process. However, on other occasions this criticism is valid and could be improved if we did better planning. Unfortunately, most of the tools we use in UDOT to manage preconstruction and construction projects do not allow the projects to be viewed simultaneously in a graphical view. For example ePM is a great tool but lacks a graphical way to show projects.

We need a better tool. We need to develop a tool to graphically display all UDOT projects (both preconstruction & construction projects) in a using a GIS web environment. This would allow project managers, PICS, media, local governments, contractors, and the public to view all projects and do better planning. The user could choose to view projects on a map by type or construction, year, PM, RE, etc. The map could allow the user to click on the road to go to the Project website. ACCURATE preconstruction and construction schedules could be view (i.e, when will construction be finished, when will it be advertised).

Strategic Goal: ☐ Preservation ☒ Operation ☒ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop a GIS website to display all preconstruction and construction projects. The GIS website would allow users to query projects based on various criteria and then display the results on an interactive map.

2. Evaluate how much the product is being used, if it is improving how we do business, & if it is of value to our external customers and partners.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Use GIS to develop a Transportation Explorer website. (1500 hours)

2. Link GIS website to ePM and PDBS databases. The would involve a effort to clean up those database so that it is GIS compatible. It could also require creating some new fields in ePM. (1500 hours)

3. Link map to project websites. (40 hours)

4. Provide training on how to use the system. (40 hours)

5. Evaluate how much the product is used and if it is improving our planning process. (80 hours)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

GIS Web Development – 6 months

Modify/Clean Database – 3 months

Implementation & Product Evaluation – 6 months

Report on project effectiveness.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT ETS has already started to develop a pilot version of this concept for Region Two using an AJ web developer and Chris Glazier's time. If funded, we could continue this effort and expand it Statewide by hiring AJs and involving ePM staff/resources.

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7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

GIS Project Tracking Website (GIS ePM)

8. Describe how will this project be implemented at UDOT.

Develop the GIS Project Tracking website, train users, and allow them to use and evaluate the system.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

PMs, Preconstruction Engineers, and planning can see graphically all upcoming and current projects and make better planning decisions. It would allow these groups to show ePM and PDBS data on a map.

UDOT management (Region Directors, etc) could use the tool to keep better track of projects.

PICs, the public, local governments, and the media could use the tool to see keep track of projects and find out project status/information.

10. Describe the expected risks, obstacles, and strategies to overcome these.

1. Product goes unused or underused.

2. Clean up ePM & PDBS databases to be GIS compatible and program some features (data fields) into ePM. This will require coordination and buyoff by ePM & PDBS management.

3. Rely on PMs and others to keep the database current.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Ed Rock - ETS

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$95,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Chris Glazier	ETS - GIS	965-4381
B) Becky Stromness	ePM	964-4518
C) Joe Kammerer	Region Two Project Management	
D) Jesse Sweeten	PDBS	
E) TOC/Commuterlink		
F) Local Govts	Public Involvement Coordinators	
G) Marketing		
H) RE's		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Consultants, AGC

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Evaluation of the Safety and Design Integrity of Two-Lane Rural Highways Using the Interactive Highway Safety Design Model (IHSDM) Developed by FHWA **No.:** 06.06-2

Submitted By: Prof. Mitsuru Saito (BYU)

E-mail: msaito@byu.edu

1. Briefly describe the problem to be addressed:

Two-lane rural highways comprise 77% of the nation's highway systems. Although VMT wise, they do not carry as much traffic as freeways and other major multi-lane highways, their share in the fatal crashes accounts for 44%. Head-on collisions and run-off the road crashes are some of the major crashes that two-lane rural roads experience. For instance, The US 6 has experienced a high number of crashes in spite of UDOT's efforts to improve the highway and UDOT has decided to upgrade it to a four-lane highway from Spanish Fork to Green River in the near future. It has been difficult to systematically evaluate the integrity of two-lane rural highways from various design and safety aspects. FHWA recently completed a suite of software programs named Interactive Highway Safety Design Model (IHSDM) that would help the engineers conduct crash prediction, design consistency evaluation, intersection review, policy review, and traffic analysis for two-lane rural highways. The availability of this software provides an opportunity for UDOT's design, operation, and safety engineers to evaluate two-lane highways with high crash occurrences from various aspects in order to identify improvement alternatives that would be most cost effective. It is necessary to proactively evaluate the need for improvement rather than reactively respond to the crashes that have occurred. IHSDM can be used to evaluate existing two-lane highways as well as newly planned two-way highways and can be effectively incorporated with safety audit practices.

2. List the research objective(s) to be accomplished:

1. Evaluate the capability of IHSDM using selected two-lane highways experiencing high crash rates as case studies.
2. Evaluate the usefulness of IHSDM for UDOT engineers to determine the effectiveness of improvement alternatives.
3. Evaluate how IHSDM can be incorporated with safety audit practices
4. Prepare a training course on use of IHSDM for UDOT engineers.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours: 1,400 hrs

1. Literature search focusing on safety and design integrity evaluation practices and safety audit of rural two-lane highways
2. Select at minimum three rural highway sections with high, medium, and low historical crash history
3. Collect geometric, traffic, and control data for the selected highway sections
4. Evaluate the selected highway sections and diagnose their problems by IHSDM
5. Compare the output of the analysis and actual highway conditions
6. Identify potential "hot" spots and their possible improvements
7. Evaluate the effects of alternate improvements that are proposed
8. Evaluate how IHSDM can be incorporated in the design, evaluation, and safety audit of two-lane rural highways
9. Develop a training course on IHSDM for UDOT engineers
10. Write a final report

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Start early June or July 2006, complete in June or July 2007.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)? University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Validation of the IHSDM
2. Proposal to UDOT to incorporate IHSDM in the process of two-lane highway safety evaluation, design, and improvement planning
3. Training course on use of IHSDM for safety audit of 2-lane highways

8. Describe how will this project be implemented at UDOT.

The IHSDM is available free of charge from FHWA. Part of the study is to find out how IHSDM fits UDOT's design process.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will have a tool and trained engineers who can interpret the designs in terms of safety, design integrity, policy compliance, and performance.

10. Describe the expected risks, obstacles, and strategies to overcome these.

* Reluctance of the engineers to use it. * Strategy – by education and training.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Robert Hull, UDOT Safety Engineer (801-965-4273)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Doug Anderson	UDOT R&D Division	801-965-4377
B) John Leonard	UDOT Traffic & Safety, Operations Engineer	801-965-4045
C) Robert Clayton	UDOT Traffic & Safety	801-965-4521
D) Peter Tang	UDOT Traffic & Safety	801-965-4285
E) Darin Duersch	Region 1 Traffic & Safety Engineer	801-620-1607
F) Tam Southwick	Region 2 SE Traffic & Safety Engineer	801-887-3717
G) Robert Miles	Region 2 NW Traffic & Safety Engineer	801-887-3792
H) Doug Bassett	Region 3 Traffic & Safety Engineer	801-227-8019
I) Troy Torgersen	Region 4 Traffic & Safety Engineer	435-893-4707

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FHWA

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Asset Improvement Tracking – (construction history)

No.: 06.03-02

(also see 06.05-05)

Submitted By: Gary Kuhl & Bill Lawrence

E-mail: Gkuhl@utah.gov

Blawrence@utah.gov

1. Briefly describe the problem to be addressed:

UDOT does not have a defined process to capture information about the changes we make to our roadways. Many database systems need to be continuously updated to reflect changes made each year.

A simple form needs to be created that can be completed by anybody doing something to the system that will capture what was done, where it was done, when it was done & how much it cost.

A more involved process needs to be developed to take this information and make it available to those database managers to update their data.

This would initially capture the data needed to update the Reference System, Plan for Every Section and Pavement Management databases, as well as the HPMS database. Changes such as adding a lane, changing the median width, placing a chip seal or overlay, and many others could all be recorded and made available from one location.

2. List the research objective(s) to be accomplished:

1. Formalize a procedure to regularly obtain the as constructed information or changes that occur to the roadway.
2. Identify what information should be recorded.
3. Develop or use a current system to enter and store this data.
4. Create reporting methods that will make this information available for use in a convenient way.
5. Identify information that is already being gathered and stored from existing databases, such as ePM, MMQA and PDBS, etc.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Identify what information is needed to update the various databases.
 - a. Question the functional managers for needs
2. Create a form to record these changes.
3. Identify who should enter this information.
4. Create a procedure to follow for data entry.
5. Correlate with "Data Warehouse" project to identify system to manage and report this information.
 - a. Hire a consultant capable of creating the needed programming to tie in.
6. Test the system.
7. Train the users on how to access the system to enter and retrieve information.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

One year project, should be completed by July 1, 2007

5. Indicate type of research and / or development project this is:

X Tweener Research Project

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

In house staff with software consultant.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Project schematic describing overall concept
2. A software application to enter, manage & report the information.
3. User documentation/manual & training program.
4. A report describing the project.
5. Department Procedure defining the process.

8. Describe how will this project be implemented at UDOT.

1. A procedure will be followed to enter changes through a web-based form.
2. As needed reports will provide database managers with updated changes to keep various databases up to date.
3. System enhancements could automate the database updates.
4. System managed by Asset Management Division.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

System changes will be recorded timely and accurately creating a history of what we did. Annual tracking can be automated. Will improve our ability to make timely decisions based on performance measures, leading to better performance and economic benefit.

10. Describe the expected risks, obstacles, and strategies to overcome these.

There needs to be consistency in data entry, both in actually doing it & in what gets recorded. Will be a challenge with the Department's schizophrenia related to computer systems.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Kim Schvanevelt, Pavement management & Planning Statistics

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$10,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Kim Schvanevelt	Systems Planning and Programming	965-4000
B) Gary Kuhl	Systems Planning and Programming	965-4000
C) Lloyd Neeley	Maintenance/Operations	965-4000
D) Bill Lawrence	Systems Planning and Programming	965-4000
E) Dave Eixenberger	Project Development	965-4000
F) Tom Leholm	Project Development	965-4346
G) Dave Blake	Region Two Materials	975-4843

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Other DOTs interested in managing their Assets.

2006 RESEARCH PROBLEM STATEMENT

No.:06.02-01

Problem Title: Install Avalanche Sentry Monitoring System

Submitted By: Liam Fitzgerald, UDOT Avalanche Safety Director

E-mail:lfitzgerald@utah.gov

1. Briefly describe the problem to be addressed:

Utah State Road 210 is the only link between Salt Lake Valley, the Town of Alta, the Alta Ski Area, and the Snowbird Resort. The thrust of this project is to provide safe travel for the motorists, and avoid prolonged or unnecessary closures that cost local business significant amounts of revenue.

UDOT currently employs a system of avalanche forecasting, closure, and explosives control to mitigate the avalanche hazard.

This project will install a sophisticated infrasound sound monitoring system and a central command unit to alert users of slides in the area of Little Cottonwood Canyon that is deemed the most dangerous, the White Pine/Tanner Flat Campground slide area. This system will also verify ordinance detonation and snow movement during UDOT's avalanche control work.

2. List the research objective(s) to be accomplished:

1. Demonstrate that distributed, time synchronized sensor array monitoring nodes can be successfully deployed in a continuously operating near real time monitoring system.
2. Confirm that infrasound monitoring can successfully be applied at the mid-canyon area of Little Cottonwood Canyon.
3. Show that the proposed infrasound monitoring system can be easily used by UDOT personnel during operations.
4. Determine whether project results justify adding required system annual maintenance costs to operational budgets, so that the system can be incorporated as permanent utility available to the UDOT avalanche mitigation program

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|-----------|
| 1. Finalize selection of sensor array monitoring sites (June 2006) | 160 Hours |
| 2. Design and install preliminary system configuration (July – October 2006) | 400 Hours |
| 3. Operate preliminary system and heuristically adjust configuration (October – May 2007) | 330 Hours |
| 4. Optimize and finalize system configuration (June – October 2007) | 310 Hours |
| 5. Operate Optimized system and evaluate performance (October – May 2008) | 230 Hours |
| 6. Project Recommendations (June – July 2008) | |
| 7. Project Conclusion, system removal or refurbishment (July 2008) | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

See Number 3.

5. Indicate type of research and / or development project this is: **Project is a Large Research Project**

Large: ☐ Research Project ☒ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant with support from UDOT Avalanche Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

8. Describe how will this project be implemented at UDOT.

Project will follow the original installation program and be utilized in other severe avalanche locations.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit by increasing the efficiency of the avalanche mitigation program through early notification of natural avalanche activity, control activity verification, ordinance detonation verification and hazard recognition. The traveling public will benefit by reducing the risk of potential avalanche hazards. The State of Utah will benefit by minimizing the economic impact of road closures.

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Rukhsana Lindsey, Director of Research, UDOT, Liam Fitzgerald, UDOT Avalanche Safety, Ernie Scott, Inter-Mountain Labs, Inc.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$100,000

(Total cost = \$150,000, but with \$100,000 commitment, National Science Foundation will participate for \$50,000)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Barry Sharp	UDOT Research	8019654314
B) Kevin Chartier	Inter-Mountain Laboratories	3076747506
C) Rukhsana Lindsey	UDOT Research Director	8019654196
D) Ernie Scott	Inter-Mountain Labs, Inc.	3077305380
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: **Development of MSE wall inspection plan based on failure mode analysis and risk assessment** **No.:** 06.07-10

Submitted By: James A. Bay & Loren Anderson, USU

E-mail: jim.bay@usu.edu

1. Briefly describe the problem to be addressed:

U-DOT has a large and growing inventory of MSE walls. These walls are a critical part of the State's transportation infrastructure. Nearly all of the critical structure of an MSE wall is buried, where it is difficult to assess its condition. Additionally, MSE walls are complicated systems where failures in several different components can lead to failure in the walls. U-DOT has variety of different types of MSE walls, which have different vulnerabilities. In order to identify and correct any problems that might arise with these walls, U-DOT needs a systematic inspection and monitoring program. We propose to develop such a program. This program will be developed based upon a probabilistic risk assessment analysis that accounts for the probabilities and consequences of failure. A panel of experts from U-DOT, the MSE wall industry, FHWA, and academia, will be assembled to determine the possible failure modes, the probabilities of failure, and the consequences of failure. Develop a failure modes analysis data base.

2. List the research objective(s) to be accomplished:

1. Develop a catalogue of U-DOT MSE walls.
2. Compile a history of MSE wall failures.
3. Assemble an expert panel to a) determine failure modes, b) assign probabilities to each failure mode, and c) evaluate the consequences of each failure mode.
4. Perform probabilistic risk assessment to identify the failure modes that contribute a significant risk for each type of wall in the U-DOT inventory.
5. Develop Failure modes analysis data base.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Develop a catalogue of U-DOT MSE walls	120 hrs
2. Compile history of MSE wall failures	60 hrs
3. Assemble expert panel and provide them with catalogue and historical data	40 hrs
4. Limited field investigation to evaluate current condition of steel reinforcement	100 hrs
5. Prepare for expert panel meeting	20 hrs
6. Conduct two day expert panel meeting	48 hrs
7. Prepare report on panels findings	20 hrs
8. Perform risk assessment analysis to identify the most critical failure modes	80 hrs
9. Develop inspection and monitoring plan to mitigate risk	100 hrs
10; Train U-DOT personnel to implement the inspection and monitoring plan	60 hrs
11. Submit final report to U-DOT	30 hrs

4. Outline the proposed schedule (when do you need this done, and how we will get there):

May-Aug 2006 Prepare for panel meetings (Tasks 1-5)
 Sep 2006 Conduct panel meeting (Tasks 6-7)
 Oct-Nov 2006 Perform risk assessment (Task 8)
 Dec 2006- Jan 2007 Develop inspection and monitoring plan (Task 9)
 Feb 2007 Conduct training for U-DOT personnel (Task 10)
 Apr 2007 Submit final report to U-DOT

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
 Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1) Catalogue of U-DOT MSE walls, 2) History of MSE wall failures, 3) Report on expert panel findings, 4) Detailed MSE wall inspection and monitoring plan, 5) Training sessions for U-DOT personnel, and 6) Final report.

8. Describe how will this project be implemented at UDOT.

The project data base will be provided to UDOT with direction on it use and recommendation for further analysis and use.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

U-DOT will benefit by having tools to asses the condition of the MSE walls in their inventory. Problems with the wall should then be identified early enough to allow for corrective actions prior to catastrophic failures.

10. Describe the expected risks, obstacles, and strategies to overcome these.

There are no particular risks in this work.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Jon Bischoff

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Jon Bischoff, Geotech		
B)	Jim Higbee, Legacy		
C)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
FHWA

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Improved Performance of MSE Walls

No.: 06.07-5

Submitted By: Travis M. Gerber, BYU

E-mail: tgerber@byu.edu

1. Briefly describe the problem to be addressed:

Several MSE wall installations on UDOT projects have not performed as intended. MSE walls are complicated systems where adverse performance of one of more components can lead to wall failures. In order to assess the risk of wall failure, a failure mode analysis will be conducted by USU. Based on the findings of this analysis, changes in design and construction procedures could reduce the risks associated with particular failure modes. This project will identify specific changes in design and construction procedures which will help UDOT reduce the risks associated with MSE wall failures.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop recommendations for revised construction and design procedures which reduce risks associated with MSE wall failure modes.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Participate in USU-initiated risk assessment panel.
2. Review results of risk assessment.
3. Correlate failure modes with elements of design and construction.
4. Conduct analytical study of wall performance in which existing design and construction procedures and proposed changes are modeled to validate and quantify the effects of the proposed changes.
5. Prepare final recommendations and report

Total estimated person hours: ~1,200 (student and faculty)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Ideally, this work would be accomplished within the six months following completion of the risk assessment.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University researcher with consultant experience, together with supervision and oversight by UDOT staff as part of technical advisory committee.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Report containing recommendations for design procedures and specifications.

8. Describe how will this project be implemented at UDOT.

Structures Geotechnical Section and Structures Design Section will use recommendations for the design and review of MSE wall installations. Recommendations can be incorporated in specifications and design guidance documents (e.g., manual of instruction).

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from improved performance and reliability of MSE walls. Also, delays and reconstruction costs which have occurred when existing MSE walls have performed adversely will be avoided.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The scope of potential changes and analysis is dependent upon the outcome of the risk assessment. Not all potential changes will be addressed.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Darin Sjoblom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$25,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Jim Higbee	UDOT – Structures, Geotechnical Section	
B) Michael Fazio	UDOT – Structures, Hydraulics Section	
C)		
D)		
E)		
F)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FHWA

2006 RESEARCH PROBLEM STATEMENT

<u>Problem Title:</u>	Estimating Peak-Flow Statistics for Ungaged Streams in Utah – Development of Regional Flow-Characteristic Regression Models and a Web-Based, GIS Model User Interface	No.:06.09-2
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Submitted By:	U.S Geological Survey, Utah Water Science Center – Patrick M. Lambert, Director	E-mail: plambert@usgs.gov
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1. Briefly describe the problem to be addressed:

Reliable estimates of a wide range of streamflow characteristics are needed by structure designers and resource managers. Throughout most of Utah, streamflow statistics are only available for gaged locations. Currently, those interested in acquiring these types of streamflow statistics for ungaged streams must conduct their own analyses. Comprehensive data acquisition, selection and proper employment of statistical techniques and quantitative evaluation of final results are critical components in these analyses but can be very costly and time consuming to obtain. Without a comprehensive geographic information system (GIS), complete with developed and evaluated streamflow statistical models, those in need of flow statistics acquire data from different sources, use an assortment of evaluation techniques, and generate results of varying confidence. A Web-based streamflow statistical tool will provide structure designers and resource managers with consistent and accurate streamflow estimates in a timely manner at low cost.

2. List the research objective(s) to be accomplished:

1. Compute flow statistics for USGS streamflow gaging stations in Utah and in drainages shared by adjoining states.
2. Develop regional regression equations for estimating a range of flow statistics for sites on ungaged streams in Utah.
3. Provide this up-to-date, statistical streamflow information for gaged and ungaged sites via an interactive Web-based tool known as StreamStats customized specifically for Utah streams.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. **Delineate statistically significant geohydrologic regions.** – Delineate geohydrologic regions using three factors: (1) statistically defined groups of similar basin and climatic characteristics; (2) significant physiographic features; and (3) scientific judgment based upon general knowledge of the area
2. **Streamflow statistics computation at gaged sites** – Calculated flood frequency estimates along with low, and monthly and annual streamflow statistics for all Utah gaging stations with 10 or more years of daily mean discharge record.
3. **Ungaged streamflow statistics estimation** – Develop regional regression equations to predict the cooperator-selected streamflow statistics at ungaged locations for each of the geohydrologic regions in Utah. These models will be built upon regional relationships between drainage basin and climatic characteristics, and computed and estimated streamflow statistics at gaging stations.
4. **Web-based user interface** – Prepare Utah geographic data for implementation into USGS national StreamStats Web-based application. StreamStats database and user interface tool will be populated with desired Utah GIS data layers. Utah streamflow gaging station statistics and developed regional regression equations will be incorporated into the national StreamStats Web-based application.

4. Outline the proposed schedule: This project is conducted by the U.S. Geological Survey in cooperation with UDOT and the Utah Department of Natural Resources (UDNR) in support of these State agency's design and resource management information needs. The project is ongoing – funded in part by the UDNR and USGS funds. UDOT funding for the project is approved in State fiscal year 2006, however the USGS/UDOT joint funding agreement has not been delivered back to the USGS office. This delay has delayed progress on the project relative to the original schedule. The project will continue on the below schedule with requested UDOT funding in FY2007.

- (1) Delineate geohydrologic regions: 4/2006-8/2006,
- (2) Computed streamflow statistics at gaged sites: 4/2006-6/2006
- (3) Estimate (model) ungaged streamflow statistics: 7/2006-8/2007
- (4) Develop GIS data base and implement web user interface and reporting – 10/2005-8/2007

All tasks will be completed by the USGS with regular reporting of progress and plans to UDOT managers.

5. Indicate type of research and / or development project this is:

Large:	<input checked="" type="checkbox"/> Research Project	<input type="checkbox"/> Development Project				
Small:	<input type="checkbox"/> Research Evaluation	<input type="checkbox"/> Experimental Feature	<input type="checkbox"/> New Product Evaluation	<input type="checkbox"/> Tech Transfer Initiative :	<input type="checkbox"/> Other	

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)? The Streamstats technology is unique to the USGS. They are also the collector and maintainer of the model data and best suited for this work.

7. What deliverable(s) would you like to receive at the end of the project? All processed and computed data will be incorporated within the Utah StreamStats web-based GIS tool and accessible to UDOT designers. For each set of statistical models that are developed, a USGS report describing their development, application and use will be prepared. Documentation for the Utah StreamStats application will be prepared and made accessible from the StreamStats interface.

8. Describe how this project will be implemented at UDOT. Project deliverables will be developed and completed by the USGS. Project products including streamflow statistics models and web-base user interface will be available for use by UDOT staff at the end of the project. Reports documenting the streamflow statistics models and user interface will be published by the USGS and made available to UDOT staff.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be. The project will:

- Provide updated, accurate information on streamflow statistics (streamflow regression models for peak-flow statistics) for gaged and ungaged sites on streams in all Utah basins.
- Incorporate all available streamflow data at gaged streams to improve the accuracy of model-computed streamflow statistics.
- Incorporate new GIS environmental-characteristic data layers, not readily available or synthesizable in previous studies, to improve the accuracy of the modeled relation between basin characteristics and streamflow.
- Create a Web-based user interface that will allow access to and use of the model via an interactive map server eliminating the need for costly independent analyses
- Allow on-the-fly basin delineation from a user-defined stream point and immediate computation of delineated basin characteristics required by the streamflow regression equations. (Basin characteristics computation via the Web applications ensures that the method for computation is the same as that used in the development of the regression equations.)
- Provide estimated streamflow statistics for user-selected ungaged sites and standard errors of estimate or prediction and confidence intervals.

Resulting tools will save UDOT designers significant time and money by allowing point and click computation of streamflow statistics needed for road and structure design near water features.

10. Describe the expected risks, obstacles, and strategies to overcome these. Timely completion of funding agreements is key to meet project timelines. The USGS will prepare a Joint Funding Agreement for each fiscal year of funding to allow use of USGS Cooperative Water Program matching funds in support of the work.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Michael Fazio, UDOT Manager, Central Hydraulics

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): UDOT project contribution in FY2006 was \$35,000. The estimated UDOT contribution in FY2007 is \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Boyd Clayton	Utah Department of Natural Resources Quality, Div. of Water Rights	538-7390
B) Todd Adams	Utah Department of Natural Resources, Div. of Water Resources	538-7272
C)		
D)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah Department of Environmental Quality, Water Quality, US Forest Service,

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Calibration and Validation of I-15 VISSIM model

No.: 06-05.7

Submitted By: Peter T. Martin and Aleksandar Stevanovic

E-mail: aleks@traffyclab.utah.edu

1. Briefly describe the problem to be addressed:

The purpose of this project is to build, calibrate, and validate VISSIM model of I-15 from SR 201 (or 600 N) to University Parkway. UDOT has started developing a VISSIM microsimulation model for evaluation of the HOT lanes on I-15 from SR 201 to University Parkway. Microsimulation models are required tools for evaluation of HOV and HOT facilities. However, microsimulation models require much more details when building and calibrating the models. The calibration of microsimulation parameters (e.g. car-following parameters, speed and acceleration distributions) is very essential to validate simulations results with the observed performance measures. The proper validation of simulation parameters will enable successful evaluation of the proposed HOT lanes on I-15. Utah Traffic Lab has a lot of experience in building and calibrating VISSIM and VISUM models.

2. List the research objective(s) to be accomplished:

1. Identify the proper calibration methodologies considering various possible scenarios
2. Already complete
3. Compare and evaluate simulated and measured travel variables and make recommendations

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Develop project scope
2. Prepare brief literature review
3. Propose research methodology (data collection, calibration, validation)
4. Integrate material and data already developed and gathered by UDOT
5. Collect data (UTL - real time connection to the TMS data)
6. Calibrate VISSIM model by using Genetic Algorithm or other optimization searching tools
7. Validate VISSIM model for an independent data set (not used in calibration)
8. Report findings to UDOT
9. Deploy Genetic Algorithm calibration tool in UDOT Planning Division.
10. Note: There is a dollar for dollar match by the MPC.

Total of 333 person-hours

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Scope and literature review – by June 2006

Methodology and model integration – by September 2006

Data collection and calibration – by January 2007

Data collection and validation – by April 2007

Report, Procedure, Training, and Software to UDOT – by June 2007

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Training, Report, Procedure, Software

8. Describe how will this project be implemented at UDOT.

UDOT Planning and TOC engineers will use the calibrated and validated model for the evaluation of HOV and potentially HOT lanes. They will also be able to use developed software for future calibration of the VISSIM models.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Beneficiaries will be engineers who will use I-15 VISSIM model for evaluation of various car pool policies on the HOV lanes or any other projects that requires VISSIM calibration in future.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Eric Rasband, Michael Kaczorowski

12. Estimate the cost of this research study including implementation effort use person-hours from No. 3 : \$30, 000(UDOT)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)		
B)		
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

The USDOT funded Mountain Plain Consortium will match the UDOT contribution dollar for dollar.

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Calibration of AASHTO's New Prestress Loss Design Equations

No.:06.08-2

Submitted By: Paul Barr and Marv Halling

E-mail: Pbarr@cc.usu.edu

1. Briefly describe the problem to be addressed:

In the next edition of the AASHTO LRFD Bridge Design Specifications the procedure to calculate prestress losses will change dramatically. The new equations are empirically based on high performance concrete from four states (Nebraska, New Hampshire, Texas and Washington). The material testing resulted in modified equations to predict elastic shortening, shrinkage and creep. Because high performance concrete has traditionally resulted in smaller prestress losses these new equations also estimate lower losses in comparison to the existing equations. Many of the bridges built in Utah do not use specifically high performance concrete, but a self consolidating concrete that is different than the mixes that were used to develop the new AASHTO equations. This research is two fold: 1- obtain design parameters elastic modulus (i.e., k_1 and k_2 for the elastic modulus) shrinkage and creep for typical Utah concrete girders mixes and 2- quantify the effects of deck casting and differential shrinkage on prestress gains to be used in the new procedures.

2. List the research objective(s) to be accomplished:

1. Obtain design parameters for elastic modulus for typical Utah prestressed concrete mix designs.
2. Obtain ultimate shrinkage and creep values for typical Utah prestressed concrete mix designs.
3. Provide design recommendations for prestress losses for typical Utah prestressed concrete mix design.
4. Quantify the effects of deck casting, differential shrinkage and camber by instrumenting a typical prestressed concrete bridge.
5. Prepare final report.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Obtain and test various concrete samples from representative precast plants (Eagle precast, Encon and possibly an Idaho plant) for elastic modulus, shrinkage and creep. (680 hours)
2. Analyze data in order to obtain design parameters for elastic modulus (k_1 AND k_2), shrinkage (ϵ_{shult}) and creep that will be specific for concrete mix designs within the state of Utah. (160 hours)
3. Instrument and monitor a prestressed concrete girder bridge to evaluate stress gains due to deck casting and differential shrinkage. (700 hours)
4. Compare design parameters with in situ results and provide design parameters for elastic shortening, shrinkage, creep, prestress gains due to deck casting and differential shrinkage. (240 hours)
5. Prepare final report (100 hours)
- 6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Task 1 – 6 to 8 months

Task 2 – 2 months

Task 3 – 12 months

Task 4 – 3 months

Task 5 (report preparation and presentation)- 1.5 months

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
 Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) The deliverable will be in terms of a report or manual of practice that provided specific design values for the calculation of elastic modulus, shrinkage and creep which would be used for the estimation of prestress losses.

8. Describe how will this project be implemented at UDOT.

This research will be implemented at the design stage for the structural engineer. With the new AASHTO design procedures, it is anticipated that engineers will use these results for each prestressed concrete bridge that is designed and built within the state of Utah.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The beneficiaries will ultimately be the tax payers. Over or under predicting prestress losses can affect both the service and ultimate limit states. When bridges are deemed to perform unsatisfactory prior to reaching an adequate design life the replacement cost can be detrimental to a DOT especially with limited budgets. This project will provide design parameters that will enable the engineer to design precast, prestressed concrete bridges that will exhibit better service performance. This will hopefully improve the service life of the bridges.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The major obstacles will be with obtaining representative samples and a representative bridge. Marv and I have recently spent time at Eagle Precast and have developed a good working relationship with their QC personnel. They seem very willing to work with and our previous experience will be valuable. We also intend to work with Encon Precast and develop similar relationships. We hope that this investment will pay dividends for both UDOT and the specific research project.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Boyd Wheeler or Ray Cook

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$80,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Boyd Wheeler		
B) Ray Cook		
C) Dan Church		
D) Robert Nash		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Any department of transportation, FHWA or design agency that will design prestressed concrete bridges using the new AASHTO procedures.

Summary List Of All Problem Statements By Group

The following is a complete list of Problem Statements considered by the various discipline groups, organized by group. Within each group, the Problem Statements are listed in sequential order, based on the number assigned before the workshop. On the left side is shown the “Priority” determined by the group. Those Problem Statements that were selected for funding are indicated with an “*” next to the Priority number. Some Problem Statements were considered by multiple groups, and have unique numbers in each group. Cross-reference numbers are shown beneath the title. If the Problem Statement was selected for funding under another number, that is noted.

Following this list, the full text of each non-funded Problem Statement is given, organized by group and by number within the group. Those Problem Statements that were listed for funding were given in the previous section of this report.

<u>Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Approx Budget</u>
<u>GROUP 1:</u>		<u>CONSTRUCTION</u>	
3	06.01-1	Method to Replace Current Certificates of Compliance	unknown
1*	06.01-2	Quality and Safety During Nighttime Construction Activities	< \$30,000
2*	06.01-3	GIS Project Tracking Website (see also 06.05-11)	\$95,000
<u>GROUP 2:</u>		<u>MAINTENANCE</u>	
2*	06.02-01	Install Avalanche Monitoring System	\$100,000
	06.02-02	Evaluation of Wet Night Visibility of Pavement Markings	\$30,000
5	06.02-03	Determine Age of Asphalt for Rehabilitation/Fourier Infrared	\$40,000
4	06.02-04	Pavement Markings under Wet Road Conditions	\$9,000
3	06.02-05	Skid Index Trigger Values	\$10,000
1*	06.02-06	Pavement Distress in 9.5mm vs 12.5 Asphalt on Thin Overlays	\$35,000

<u>Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Approx Budget</u>
<u>GROUP 3:</u>		<u>MATERIALS & PAVEMENTS</u>	
5	06.03-1	Plan for Every Section- Safety Information (also see 06.05-1)	\$40,000
2*	06.03-2	Asset Improvement Tracking – (construction history) (also see 06.05-5)	\$10,000
6	06.03-3	Assessment of Mud Balance Test for Quality Assurance (also see 06.07-3, funded under that number)	\$10,000
3	06.03-4	Pavement Design Data on the Web	\$50,000
4	06.03-5	Binder Fingerprinting	\$60,000
1*	06.03-6	Hamburgh HMA Field Research	\$60,000
7	05.03-3	SMA Paving Mechanistic Properties	\$100,000
<u>GROUP 4:</u>		<u>ENVIRONMENTAL</u>	
	06.04-1	Conducting Water Quality Analyses for NEPA Transportation Projects	\$80,000
3	06.04-2	Elk Crossing Design	\$35,000
	06.04-3	Assess detention basin design and operation to determine water quality	\$50,000 to 75,000
1*	06.04-4	Development of an indirect wildlife impact methodology	\$96,000
2	06.04-5	Fish Passage at Utah Culverts: Strategy, Assessment, and Design (see also 06.09-1, funded under that number)	\$74,000

<u>Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Approx Budget</u>
<u>GROUP 5:</u>		<u>PLANNING & ASSET MANAGEMENT</u>	
4	06.05-1	Plan for Every Section- Safety Information (also see 06.03-1)	\$40,000
7	06.05-2	Cross-Asset Analysis: fair comparison among asset classes	\$20,000
	06.05-3	UDOT Database Integration	\$20,000
5	06.05-4	Prioritization of Bicycle and Pedestrian Improvements	\$20,000
3	06.05-5	Asset Tracking – (construction history) (also see 06.03-2, funded under that number)	\$30,000
1*	06.05-6	Seismic Vulnerability and Emergency Response of UDOT Lifelines (also see 06.06-8)	\$25,000
2*	06.05-7	Calibration and Validation of I-15 VISSIM model	\$45,000
	06.05-8	Data Management System for Systems Planning and Programming	\$40,000
6	06.05-9	An Evaluation of Toll vs. HOT Lane Facilities	\$30,000
	06.05-10	Alternative Light Wavelengths for Automated Pavement Distress Data Collection	??
	06.05-11	GIS Project Tracking Website (see also 06.01-3)	\$95,000
	06.05-12	3D Photolog	\$130,000

<u>Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Approx Budget</u>
<u>GROUP 6:</u>		<u>TRAFFIC MANAGEMENT & SAFETY</u>	
	06.06-1	Crash Data Mining - Safety Effectiveness of Roundabouts in Utah	\$20,000
2*	06.06-2	Evaluation of the Safety and Design Integrity of Two-Lane Rural Highways Using the Interactive Highway Safety Design Model (IHSDM) Developed by FHWA	\$35,000
1*	06.06-3	A Safety Analysis of Fatigue and Drowsy Driving	\$39,500
	06.06-4	An Analysis of Median Crossover Crashes in Utah	\$30,000
	06.06-5	Traffic Impact Analysis Training (Permitting, Safety, Design)	\$35,000
	06.06-6	Testing and Evaluation of Non-Intrusive RWIS Instruments	\$135,000
4	06.06-7	SCATS (Sidney Coordinated Adaptive Traffic System) Evaluation	\$50,000
	06.06-8	Seismic Vulnerability and Emergency Response of UDOT Lifelines (see also 06.05-6, funded under that number)	\$100,000
	06.06-9	Validation of RappidMapper, Inc.'s LD3 Software Technology	\$90,000
3	06.06-10	Automated Delay Estimates and Other MOE's for Traffic Signals	\$30,000
	06.06-11	Highway Advisory Radio (HAR) - Evaluation, Standardization & Innovation	\$20,000

<u>Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Approx Budget</u>
<u>GROUP 7:</u>		<u>GEOTECHNICAL</u>	
	06.07-1	Characterization of shear strength and mechanics of landslides in the Manning Canyon Shale	\$20,000
	06.07-2	Assessment of impacts to infrastructure along SR 167 & 226 due to landslides in the Norwood Tuff	\$15,000
3*	06.07-3	Assessment of mud balance test for Quality Assurance in Ground Anchor Installation (also see 06.03-3)	< \$10,000
4	06.07-4	Investigation for Utah County Liquefaction Hazard Maps	\$40,000
2a*	06.07-5	Improved Performance of MSE Walls	\$25,000
1*	06.07-6	Stone Column Treatment with Wick Drains in Silty Sands	\$30,000
	06.07-7	Biotechnical Stabilization and the use of Phreatophytes	\$12,000
	06.07-8	Nonlinear Dynamic Behavior of Soils at a Major Structure	\$24,000
	06.07-9	Measured low-strain site response at a major structure	\$7,000
2*	06.07-10	Development of MSE Wall Inspection Plan Based on Failure Mode Analysis and Risk Assessment	\$40,000

<u>Priority</u>	<u>Prob No.</u>	<u>Problem Title</u>	<u>Approx Budget</u>
<u>GROUP 8:</u>		<u>STRUCTURES</u>	
1*	06.08-1	Evaluation of Bridges for Seismic Isolation Retrofit	\$120,000
2*	06.08-2	Calibration of AASHTO's New Prestress Loss Design Equations	\$80,000
	06.08-3	Investigation of Past and Present Corrosion Monitoring, Evaluation, and Mitigation of Bridge Decks	\$35,000
	06.08-4	Dynamic Analysis of Integral Bridge Pier System	\$30,000
3	06.08-5	Develop overhead sign structure standard drawings	\$150,000
<u>GROUP 9:</u>		<u>HYDRAULICS</u>	
1*	06.09-1	Fish Passage at Utah Culverts: Strategy, Assessment, and Design (see also 06.04-5)	\$74,000
2*	06.09-2	Estimating Peak Flow Statistics for Ungaged Streams in Utah-Development of Regional Flow Characteristic Regression Models and web-based, GIS Model User Interface	\$70,000
5	06.09-3	Critical Slope For Trench Drain Installations	\$10,000 to 30,000
3	06.09-4	Calibration of Curve Numbers (CN) for estimating runoff in rural ungaged streams in Utah	\$35,000
4	06.09-5	Calibration of time parameters and synthetic unit hydrograph coefficients for Utah watersheds	\$57,000
	06.09-6	Assessing ownership and location of storm drains and sewer within UDOT Right-of-way	\$20,000 to 50,000

2006 RESEARCH PROBLEM STATEMENT

**Problem
Title:**

Method to Replace Current Certificates of Compliance

No.: 06.01-1

Submitted By: Peter Negus, P.E.

E-mail:

1. Briefly describe the problem to be addressed:

Currently, UDOT requires Certificates of Compliance that are used as a means to assure that material incorporated into a project meets specification. This process has been in place since the beginning of the interstate program and has evolved into a practice that doesn't accurately represent the quality of the material placed on projects, requires excessive man hours to monitor and erodes the morale of construction personnel.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop a less labor-intensive method to assure compliance that addresses UDOT needs.

2.

3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Determine how other DOT's assure quality of material incorporated into projects.

2. Develop new method to assure compliance incorporating techniques from other DOT's , or create a new method independent of other DOT's practices.

3.

4.

5.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

New method should be developed in one (1) year.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Recommendation of a method or procedure that would replace the existing process.

8. Describe how will this project be implemented at UDOT.

A new method would be developed and would have to be approved by the FHWA. Training for construction personnel would be minimal, since the new method would not be difficult or cumbersome.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Documentation of material incorporated into projects will be accurate and will represent the quality of the material. Considerable time will be saved by construction personnel and morale will improve.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The major obstacle will be the resistance to change from a method that has been in place for decades and is ingrained in the UDOT psyche.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Peter Negus, P.E. Deputy construction Engineer

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Stan Adams, P.E.	Construction Division	965-4242
B) Dennis Simper, P.E.	R-1 Construction Engineer	801 620-1650
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Evaluation of Wet Night Visibility of Pavement Markings

No.:06.02-02

Submitted By: Mitsuru Saito

E-mail:msaito@utah.edu

1. Briefly describe the problem to be addressed:

Approximately half of the fatal crashes on the nation's highways occur at night, despite the fact that travel at night is significantly less than during the daytime. There is also correspondingly higher number of injuries and more property damage resulting from night crashes. FHWA believes that delineation treatments may represent the most highly cost effective approach. At segments where roadside lighting is not adequate or none, retroreflectivity of pavement marking is the only guidance that drivers receive to keep their vehicles in the right lane. There has been an effort to determine night time visibility of pavement markings on dry pavement, but not much work has been done on the night-time visibility of pavement markings on wet pavement in the rain. Deterioration of retroreflectivity of pavement marking may contribute to incorrect decision making. It is essential to provide necessary visible distance for an emergency stop on wet pavement at night to ensure the reduction in crash potential. Hence, there is a need to study in the field the night time visibility of pavement markings on wet pavement in the rain. Some laser-based retroreflective measurement equipment can be used to measure retroreflectivity at a stationary position. Drivers, however, must make decisions while driving constantly evaluating the visible pavement markings; hence, the visibility of pavement markings on wet-night pavements must be evaluated while the vehicle is in motion, as well as their static retroreflectivity.

2. List the research objective(s) to be accomplished:

1. Determine the visibility of the retroreflective pavement markings currently used by UDOT on wet-night pavement
2. Determine the night-time visibility of retroreflective pavement markings on dry-night pavement
3. Determine the level of degradation in the visibility level of pavement markings on dry- and wet-night pavement

3. List the major tasks required to accomplish the research objective(s):One Year Study

Estimated person-hours: 1200 hours

1. Conduct a literature search on visibility and retroreflectivity levels of pavement marking on wet-night pavement.
2. Select several study sites with Conduct a straight alignment and paint the sections with various pavement marking materials that UDOT currently uses or plans to use. (Or, select several existing sections that UDOT desires to evaluate.)
3. Place location markers to assist data collection persons to estimate visible distances.
4. Collect field data on dry-night pavement: retroreflectivity and visibility.
5. Conduct field data on wet-night pavement: retroreflectivity, visibility. Rain intensity data are also collected.
6. Analyze the field data.
7. Develop a plan of action to inform Utah drivers about the visibility constraint of pavement marking on wet-night pavement and to promote safe wet-night driving.
8. Write a final report.

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc)

The results of this study provide two types of information. Among the types of pavement marking, which one would be most retroreflective; they also provide data about how far ahead in the rain drivers can see the pavement markings. They can be used to educate the public about the danger of driving in rainy weather.

5. What deliverable (s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

1. Retroreflectivity or visibility of pavement markings on wet-night pavement
2. Plan of action to educate motorists about the risk of driving on wet pavement in the rain

6. Who in the Department could be direct end-users of this study's results?

Traffic & Safety Division, UDOT Region Traffic Engineers

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Final Report, public information action plan.

8. Describe how will this project be implemented at UDOT.):

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By educating the drivers about the loss of visibility on wet pavement at night and elevated accident potential on wet pavement

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Rukhsana Lindsey

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$30,000

Note that this budget does not include the cost that may be incurred by UDOT personnel to conduct field studies whenever rain fall at night. It only includes budgets for design of experiment, statistical analysis, and report writing and the costs for transportation, communication, and report creation by the BYU research team.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Mitsuru Saito	BYU	422- 6326
B) Lloyd Neeley	Central Maintenance	965- 4789
C) Lynn Bernhard	Central Maintenance	964-4597
D) Rukhsana Lindsey	Research Director	965- 4196
E) Barry Sharp	UDOT Research	965-4314
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, NCHRP, State DOT's

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Determine the Age of Asphalt Pavements for Rehabilitation/Fourier Transform Infrared **No.:**06.02-03

Submitted By: Barry Sharp/Rukhsana Lindsey

E-mail: rsharp@utah.gov

1. Briefly describe the problem to be addressed:

There is no active non-destructive test method to determine the oxidation of asphalt in asphalt pavements. A fast, sensitive method to determine the concentration of the oxidized species in asphalt pavements may be available through infrared analysis called the Fourier transform infrared (FTIR) or surface reflectance.

2. List the research objective(s) to be accomplished:

1. Determine sample taking process for repeatability and minimum sample size
2. Separate the asphalt oil from the sample by centrifuge
3. Check the asphalt for aging
4. Determine treat or not to treat limits on resulting test results
5. Determine minimum number of samples

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|-----|
| 1. Determine representative pavements to be included in the study | 50 |
| 2. Obtain samples for testing and grading | 200 |
| 3. Process samples and index/categorize | 500 |
| 4. | |
| 5. | |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Organize a TAC to set guidelines and allow consultant to guide the group through the process	June 2006
Start sampling process	November 2006
Test the samples and index	June 2007

5. Indicate type of research and / or development project this is: Large Research Project

Large: ☐ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Weber State University administered by Dr. E. Park Guyman and Andrew Lippert

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Formulate an index for treat no treat limits and the age of the surface samples obtained and evaluated of the asphalt (Phase One)

8. Describe how will this project be implemented at UDOT.

Upon completion of Phase One a new research proposal will be submitted to develop a hand held device (light, color,) that may incorporate laser technology or infrared technology

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will have available a hand held device that will result in measuring the age of asphalt pavement surfaces and allow UDOT to make an objective decision regarding the surface treatment whether it be rejuvenation, fog seal, or overlay and will allow UDOT to better utilize their resources and not treat asphalt pavements when they do not require treatment

10. Describe the expected risks, obstacles, and strategies to overcome these.

The second Phase will be more difficult to accomplish than the first phase of just indexing the test results of various asphalt pavements determined to become part of the study

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Dr. E. Park Guyman and Andy Lippert from Weber State University, Barry Sharp, UDOT Research, Rukhsana Lindsey, Research Director

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)		
B)		
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Pavement Markings under Wet Road Condition

No.:06.02-04

Submitted By: Vincent Liu

E-mail: vliu@utah.gov

1. Briefly describe the problem to be addressed:

In consideration of active winter maintenance activities in Utah, the thickness of pavement markings above road surface is limited. This creates a very difficult time for motorists to see pavement markings under wet road condition.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Install recessed retroreflective pavement markings on certain state routes.
2. Search for other methods to improve the problem.
3. Search and recommend for other pavement marking materials.
4. Specifically focus on wet pavements.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours 300

1. Field test – to install different pavement materials/methods on testing section(s).
2. Inspect– to inspect pavement markings when roadway is wet; take retroreflectivity readings when roadway is dry; document, and take pictures.
3. Analyze data
4. Make recommendations

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Field test in 2006

Inspect and record data by event, take retroreflectivity reading monthly

Analyze and make recommendations in June, 2007

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation ☐ Experimental Feature ☒ New Product Evaluation ☐ Tech Transfer Initiative :

Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or UDOT

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Recommended methods and products for UDOT decision-makers, and information for public information / education campaign.

8. Describe how will this project be implemented at UDOT.

We could first implement to in-house maintenance use, then outsourcing if it is necessary.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Increase safety – Public and UDOT

10. Describe the expected risks, obstacles, and strategies to overcome these.

Snow removing operation is a concern.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Vincent Liu

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$9000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Vincent Liu	Central Maintenance	801-965-4077
B) Dan Betts	Region Two	801-910-2430
C) Barry Sharp	Research	801-965-4314
D) Rich Clarke	Central Maintenance	801-965-4120
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Skid Index Trigger Values

No.:06.02-05

Submitted By: Lloyd R. Neeley

E-mail: lneeley@utah.gov

1. Briefly describe the problem to be addressed:

UDOT currently has in place a guideline for which values of skid index are considered standard, marginal, or deficient. UDOT practice is for Program Development to notify the Regions when skid index values for a section of pavement become deficient, and to advise them to program a corrective treatment, and to post the section as "Slippery When Wet" until such time that a corrective treatment can be applied. Logically, however, some values of skid index present more of a hazard than others. The intent of this problem statement is to determine what value of skid index would require UDOT to take immediate corrective action, as opposed to merely placing a corrective treatment on the program.

UDOT Planning is currently doing the following:

1. Review and summarize UDOT's original research used to establish the existing guideline.
2. Review and summarize measures used in other states to quantify skid resistance, reporting of those measures to interested parties, and trigger values for corrective action. Report on any differences between UDOT's measures and those used in other states.
3. Investigate and report on the relationship between UDOT's skid index and other material properties related to skidding such as the coefficient of friction.
4. Recommend values of the skid index which should be considered standard, marginal, deficient, and seriously deficient (requiring immediate corrective action).

The intent of this study is to use UDOT accident data and skid data, for different functional classifications, to investigate statistical relationships between wet weather accidents and various values of skid index. Combine functional classifications as necessary to obtain statistically valid sample sets. Identify the most clear relationships, with emphasis on distinctions between levels of hazardous condition.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Establish guidance values of the skid index for use in evaluating appropriate action related to skid resistance.
2. Produce a report that explains the relationship between skid index and level of hazard in practical terms.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

Use UDOT accident data and skid data, for different functional classifications, to investigate statistical relationships between wet weather accidents and various values of skid index. Combine functional classifications as necessary to obtain statistically valid sample sets. Identify the most clear relationships, with emphasis on distinctions between levels of hazardous condition.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Summer / Fall 2006 – Compile existing data and conduct the analysis.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐
Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, in combination with UDOT staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

- Report describing the original research used to establish UDOT's current guideline and practice, describing other states' practices, and describing the meaning of the skid index in both theoretical and practical terms.
- Report describing the current research effort, including data used, analysis methodology, and results and conclusions.
- Recommended indicated corrective measures for identified deficient pavements.

8. Describe how will this project be implemented at UDOT.

Guidance document be distributed to Region Traffic, Pavement, and Operations Engineers.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Guidance for region engineers making decisions with regard to action for highways with lower skid values.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Bill Lawrence

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$10,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Bill Lawrence	UDOT Program Development	965-4158	
A) Lloyd Neeley	UDOT Central Maintenance	965-4789	
B) Gary Kuhl	UDOT Program Development	964-4552	
C) Wayne Felix	UDOT Region 1	(801)620-1606	
D) Doug Anderson	UDOT Research	965-4377	
E) Russ Scovil	UDOT Program Development	965-4097	
F)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, UDOT Traffic and Safety, UDOT Risk Management

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Plan for Every Section- Safety Information

No.: 06.03-01
(also see 06.05-01)

Submitted By: Doug Anderson

E-mail: dianderson@utah.gov

1. Briefly describe the problem to be addressed:

Safety related information is crucial when making decisions related to roadway improvements and preservation. The Plan for Every Section maintained by the region staff could benefit from data and information related to the safety aspects of each section. Information from various databases within UDOT could be listed in a common report that would summarize the safety needs of each section. As activities are planned within highway sections. These databases include CARS (Traffic & Safety), Pavement Condition (Planning), Features Inventory (Maintenance), and Bridge Inventory (Structures Division).

Information that may be included in the reports are: skid index, rut depths, roughness, edge drop-offs, slope flattening needs, drainage problems, rumble strip requirements, deer fence deficiencies, school zone problems, fatigue related crashes, sharp curve issues, narrow bridge problems, black ice on bridge decks, obscured vision due to trees or weeds, and the need for curb, cutter or sidewalks.

2. List the research objective(s) to be accomplished:

1. Identify what information is needed by the decision-makers using the Plan for Every Section.
2. Deliver the information to the users in a format that is easily understood and applied to our projects and programs.
3. Create the needed reports and tables needed by the users.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours: 800 hours

1. Determine what safety related information is needed by the decision-makers using the Plan for Every Section.
2. Design a reporting system that is easily queried, and downloaded. The report format should be as simple or complex as needed by the user.
3. Hire a consultant capable of creating the needed database and reporting system.
4. Release a beta version of the system for review and comments.
5. Train all users on how to access and interpret the information.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Should be completed by July 1, 2007.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

In-house and software consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Project schematic describing overall concept
2. A software application to enter, manage & report the information.
3. User documentation/manual & training program.
4. A report describing the project.
5. Department Procedure defining the process.

8. Describe how will this project be implemented at UDOT.

1. A procedure will be followed to enter changes through a web-based form.
2. As needed reports will provide database managers with updated changes to keep various databases up to date.
3. Software submitted to the PM staff
4. Reports added to each section plan.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The reports should be useful for 10 years or longer. Users will include Maintenance Engineers, PM Engineers, Maintenance personnel, Safety Coordinators, Project Managers, and designers.

10. Describe the expected risks, obstacles, and strategies to overcome these.

1. Decision needs to be made on whom this really belongs with. Should it be FFES or Traffic and Safety.

2. There are problems when information from various databases is extracted for use. Users will need to have a basic understanding of how to interpret the information contained in the reports.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Traffic & Safety staff, region staff responsible for projects and programs within the roadway.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Doug Anderson	Research Division	965-4377
B) Rob Clayton	Traffic and Safety	965-
C) Wayne Felix	Region 1 Materials	399-0351
D) Matt Parker	Region 3 Materials	227-8023
E) Dave Blake	Region 2 Materials	975-4843
F) Glen Ames	Systems Planning and Programming	965-
G) Degen Lewis	Region 3 Traffic and Safety	227-8000

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

MPOs could benefit from the information. Some city and county governments could use the information. Enforcement agencies could use the data if we choose to include information such as DUI related crashes, speed related accidents, truck crashes, etc.

2006 RESEARCH PROBLEM STATEMENT

Problem Title:	Assessment of Mud Balance Test for Quality Assurance in Ground Anchor Installation	No.: 06.03-03 & 06.07-03
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Submitted By:	Clifton Farnsworth	E-mail: cliftonfarnsworth@utah.gov
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1. Briefly describe the problem to be addressed:

In the Provo Canyon Reconstruction Project we are installing thousands of feet of ground anchors (ie soil nails and rock dowels). Our current specs require the contractor to take two cube samples per day and test them to verify the grout strength. This allows verification of the grout strength at 14 days and 28 days after installation as to whether the grout met strength. However, in the meantime the Contractor can be several rows lower and if there is a problem it is almost too late too fix it. The Post Tensioning Institute recommends using the mud balance test as a means of testing the grout strength upfront. The correlations between the specific gravity (which is measured with the mud balance) and compressive strength are very good for a grout comprised of only cement and water, which is what is being used as nail grout. Grout cubes are still taken periodically to ensure that the correlations are being met. We proposed at one point a while ago that this method be used on the Provo Canyon Reconstruction, but were rejected because UDOT is unfamiliar with the mud balance test. We propose to gather cube samples from the actual construction project, perform the mud balance on the same batch of grout, and gather a set of data from the field that show the correlations between the two.

2. List the research objective(s) to be accomplished:

1. Literature search on the specific gravity (mud balance) test.
2. Use the current construction as a means of gathering mud balance and grout cubes results to show the correlations between the two.
3. Recommendations for any adjustments that may need to be made to the soil nail / rock dowel specifications.
4. Include maturity meter information for direct strength correlation.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|--|
| 1. Literature search and review. | 10 hours |
| 1a. Develop maturity curves | |
| 2. Perform mud balance and make grout cubes. | Time Donated by Provo Canyon Team |
| 2a. Perform field assessment of maturity. | |
| 3. Break grout cubes. | Cost to Break Each Cube (5 hours per week) |
| 4. Compile correlation curves for cubes and maturity. | Time Donated by Provo Canyon Team |
| 5. Report and Recommendations for Spec Change | 20 hours |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The contractor is currently installing soil nails and rock dowels and will be throughout the summer. As soon as we can get things in place we can begin gathering data. They mix up many batches of grout throughout the day at several different locations on the project, so we can also test at various times of the day and in various locations along the project. We anticipate that the work will have to be done by the end of summer though as the soil nails / rock dowels will hopefully be completed.

ASAP – THIS SUMMER

5. Indicate type of research and / or development project this is:

Large:	<input type="checkbox"/> Research Project	<input type="checkbox"/> Development Project			
Small:	<input checked="" type="checkbox"/> Research Evaluation	<input type="checkbox"/> Experimental Feature	<input type="checkbox"/> New Product Evaluation	<input type="checkbox"/> Tech Transfer Initiative	
	<input type="checkbox"/> Other _____				

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT staff (Provo Canyon Team), possibly consultant performing the actual cube breaks.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Report summary of testing and results
2. Correlation graphs
3. Recommendations as to how the specification can be modified allowing for better QA/QC.
4. Implementation plan

8. Describe how will this project be implemented at UDOT.

Future projects that use soil nails and rock dowels may utilize the mud balance of a means of testing up front and verifying the strength immediately as opposed to having to wait the two to four weeks to make sure we are meeting the desired strength.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By using the mud balance with periodic cube sampling to verify the correlations, it is felt by the champions of this proposal that a better end product (soil nails and rock dowels) can be achieved. There is definitely the possibility to identify potential problems up front rather than waiting for the cube breaks.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The mud balance and cube sample construction take place in the field, right in the mix of the construction environment. This sometimes allows for error to creep into the data, as opposed to being done in a pristine lab environment. However, this can also be a good thing, as the numbers show what is really happening in a real life situation. Those performing the mud balance and cube samples will have to identify a uniform way of doing this to eliminate error.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Clifton Farnsworth and Jim Golden (Region 3 Construction)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): Under \$20,000 (still getting a feel for this)

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Clifton Farnsworth	Region 3 Construction – Provo Canyon Crew	801-830-9314
B) Jim Golden	Region 3 Construction – Provo Canyon Crew	801-222-3436
C) Scott Andrus	Region 3 Construction	801-227-8029
D) Darin Sjoblom	UDOT Geotechnical Division	801-964-4474
E) Concrete Engineer	Central Materials	965-????
F) Ben Blankenship	Ashgrove Cement	263-3011
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Pavement Design Data on the Web

No.: 06.03-04

Submitted By: Doug Anderson

E-mail:

1. Briefly describe the problem to be addressed:

UDOT is implementing the new M/E Pavement Design Guide. Providing accurate data for use in pavement designs is a crucial aspect of realizing the benefits the new guide can produce. This project would web-enable three data categories of the guide. 1- The Materials Library created by ERES Consultants will contain all data from laboratory testing around the state. 2- Traffic Design Data will be acquired for each project based on the site-specific needs of the corridor. 3- Default Parameters for Utah and some specific locations within Utah will be maintained.

The benefits of web-enabling these data types will be significant, especially considering the decentralized nature of UDOT. Designers in the regions and approved consultants will have timely and efficient access to the data needed to generate a quality pavement design. The Planning Division can post the most current traffic information for projects on the STIP that can be efficiently downloaded. Default values can be updated statewide to ensure consistency.

2. List the research objective(s) to be accomplished:

1. Web-enable the Materials Library to allow both input of test data and download of information into the design software.
2. Web-enable the Traffic Design Data to allow both input of test data and download of information into the design software.
3. Web-enable the Default Parameters to allow both input of test data and download of information into the design software.
4. Build security aspects into the system in the form of logon IDs and passwords. Some users will be given input rights, while others will be allowed to download data only.
5. "Easy Button" for data access – a GIS environment for project identification and data acquisition (pick a location, get a list of inputs)
6. Link to Materials Database

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours 500

0. FINISH THE #&#\$%^&*&#%*(^%\$#%^&*^%\$# MATERIALS LIBRARY!!!!!!!!!!!!!!!!!!!!!!!!!!!!

1. Acquire the formats of the Materials Library, Traffic Design Data, and Default Parameters.
2. Become familiar with the required formats in the M/E Design Guide software.
3. Design the web site to accommodate the existing formats and produce the required output formats.
4. Build search capabilities into the system allowing the user to find information by project, region,
5. Build user-friendly functions into the system including "Save" buttons, "Print" buttons, term definitions, online help function, and others.
6. Provide a Final Report and User's Manual on the system.
7. Train users on the system.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

- The software will be submitted to UDOT. Training will be offered to all approved users.
- As soon as possible!
- (After the Materials Library is finished!!!!!!)

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
 Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant – i.e. ARA, inc.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Software, Final Report, PowerPoint Presentation, and User's Manual.

8. Describe how will this project be implemented at UDOT.

Full access by Materials Engineers, Pavement Management Engineers, Traffic technicians,
Read only access by outside stakeholders

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The needed data for the new M/E Pavement Design Guide will be efficiently input and exported to conduct designs. This information from various sources will be focused into one location to reduce the person-hours required to analyze and process the data. The accuracy of the data will be enhanced through this system.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Risks are low. The main obstacle is getting the [materials library finished and the] system properly populated with information. With policies in place and training completed experts should see the value of web enabling the data.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Brent Hadfield

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Rod Terry	Region 1 Materials	
B) John Butterfield	Region 2 Materials	
C) Jim Cox	Region 3 Materials	
D) Larry Gay	Region 4 Materials	
E) Todd Emery	FHWA	
F) Brent Hadfield	Central Materials	
G) Some Dude(tte)	DTS	

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

FHWA, some local governments

RESEARCH PROBLEM STATEMENT

Problem Title:

Fingerprinting Binder Modification Methods

No.: 06.3-5

Submitted By:

Kevin VanFrank

E-mail: kvanfrank@utah.gov

1. Briefly describe the problem to be addressed:

Base asphalts can be modified in a variety of ways to meet the SHRP performance grading (PG) parameters. These methods include adding both organic and inorganic compounds to obtain the PG requirements. Various combinations of these compounds yield nearly identical PG properties using the SHRP physical indicator tests. Although the binder formulations look the same using the current grading tests, they behave very differently when combined with different aggregates. A chemical fingerprinting method may be needed to assure that once a formulation is settled on, it remains consistent.

Research into the availability of rapid chemical fingerprinting tests to identify and quantify the most common organic and inorganic modifiers used in formulating binders would help to avoid having to field test the mixes for high and low end physical properties.

Strategic Goal:

☒ Preservation

☐ Operation

☐ Capacity

☐ Safety

(Check all that apply)

2. List the research objective(s) to be accomplished:

1. Identify methods of modifying locally available base binders to meet PG requirements.
2. Identify rapid methods to chemically fingerprint these modifying compounds.
3. Develop precision parameters around these tests and modification techniques for use in developing control specs.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours Too Many

0. Literature search on what is currently being investigated/parallel studies.
 1. Identify the locally available base asphalts
 2. Identify the additives that are used to modify the high and low temperature properties to meet the existing PG requirements.
 3. Identify rapid methods to chemically fingerprint these additives.
 4. Identify the repeatability of these tests.
 5. Identify the expected variability expected in a well-controlled production process.
 6. Propose variability limits for inclusion in specification.
 7. Develop implementation process for training industry and incorporating into projects.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Would like to see this begin during (2006) construction season, with delivery of recommended tests Oct. 2006 and delivery of variability limits by March 2007.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project

☐ Development Project

Small: ☐ Research Evaluation

☐ Experimental Feature

☐ New Product Evaluation

☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant-University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Interim reports to indicate current experience and best to date specification assumptions.
2. Final report to summarize data and provide guidelines for testing and specification limits.
3. Definition/description of test and it's intended results
4. Implementation plan
5. Specifications/special provisions
6. Literature Review Summary (state of the practice)

8. Describe how will this project be implemented at UDOT.

The test methods and limits would be incorporated in the binder management plan. Will have to be over a several season period to allow the industry to become familiar with it.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

By assuring the consistency of the binder feed stream, UDOT could avoid complicated and time consuming field-testing for high and low temperature mix properties. Will also avoid the probability of a contractor changing binder formulations significant enough to affect mix properties but subtle enough to no be picked up by the SHRP PG system.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Cost of new equipment (either by purchasing or developing)
Industry may not agree with this concept.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Kevin VanFrank UDOT Engineer for Asphalt Materials (801) 965-4426

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$60,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended
A) Tim Biel	UDOT Central Materials	965-4859	n
B) Kevin VanFrank	UDOT Central Materials	965-4426	
C) Kevin McKinney	UDOT Central Materials	965-4295	
D) Stephane Charmont	SemMaterials	673-6579	
E) Pedro Romero	U of U(tah)	587-7725	
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

All other states, could be a FHWA Pooled Fund Project.

RESEARCH PROBLEM STATEMENT

Problem Title:

SMA Paving Mechanistic Properties

No.: 05.3-3

Submitted By:

Rodney Terry

E-mail: rodterry@utah.gov

1. Briefly describe the problem to be addressed:

With the growing use of Stone Matrix Asphalt pavement (SMA) it's mechanistic design properties: resilient modulus, dynamic modulus, flexural strength and cold weather cracking susceptibility, need to be known to full benefit of its contribution to the paving system.

The information to be gathered/evaluated would be resilient modulus and dynamic modulus of SMA mixes used in Utah. Additional test to be run on selected mixes to get the cold weather and fatigue and other information Ie. Bending beam TSRT etc. These tests could be run at UNR or other Superpave center throughout the country.

Strategic Goal:

☒ Preservation

☐ Operation

☐ Capacity

☐ Safety

(Check all that apply)

2. List the research objective(s) to be accomplished:

1. Learn the true mechanistic properties of SMA used in Utah and validate design assumptions.
2. Develop the Structural Number to be used for SMA layers in pavement designs using the current AASHTO design method.
3. Develop inputs for the SMA layer to be input into the mechanistic design process.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Develop a testing strategy and data collection process for Dynamic Modulus data using the Simple Performance Testers that are to be in place at each Region, and non-DOT testing devices for calibration and correlation. – Will require definition of a SPT FOP.
2. Evaluate data from modulus testing to determine default values for pavement design guides.
3. Develop testing strategy and implement testing strategy to develop cold weather and fatigue data.
4. Evaluate data from testing and develop appropriate design guide input and department guidelines.
5. Populate Materials Library for the ME Design Process
6. Crunch designs to validate inputs.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Would like to see this begin during (2005) construction season, with delivery of SPTs in Regions, and last over two seasons to gather a sufficient amount of data with interim reports annually and a final report at conclusion

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project

☐ Development Project

Small: ☐ Research Evaluation

☐ Experimental Feature

☐ New Product Evaluation

☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant-University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Interim reports to indicate current experience and best to date design assumptions for modulus and other design inputs.
2. Final report to summarize data and provide guidelines for SMA design and use.
3. Materials Library data values
4. SPT FOP

8. Describe how will this project be implemented at UDOT.

The design parameters for SMA would be included in department pavement design guide.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Better understanding of the SMA design parameters will allow the pavement designer to optimize the use of SMA in pavement design and realize cost savings in the overall pavement system.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Rodney Terry, Region 1 Materials Engineer, 801-399-0354

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$100,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Tim Biel	UDOT Central Materials	965-4859	y
B) Kevin VanFrank	UDOT Central Materials	965-????	Y
C) Steve Niederhauser	UDOT Central Materials	965-4293	
D) Mohommad Rahman	Granite Construction	526-6130	y
E) Doug Watson	CMT EngineeringLaboratories	936-1567	
F) Larry Gay	UDOT Region 4 Materials	435-896-1306	y
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Conducting Water Quality Analyses for NEPA Transportation Projects **No.: 06.04-01**

Submitted By: Jerry Chaney, UDOT Environmental Services **E-mail:** jchaney@utah.gov

1. Briefly describe the problem to be addressed:

NEPA requires that sponsors of transportation projects consider the impacts of these projects on water quality and water resources. Currently there are numerous methods available to perform these analyses, but little or no guidance on the best to use for different situations. Some methods developed by the EPA and FHWA may be more suited for detailed project level analyses and some, better suited for planning level studies and watershed based analyses. It would be helpful to know which methodologies are best suited for detailed project level NEPA analyses.

Also, a FHWA publication titled "Evaluation and Management of Highway Runoff Quality" was developed and distributed in June 1996; it would be beneficial if this publication were reviewed to determine if it is still adequate for use, since it is approaching 10 years from date of release.

2. List the research objective(s) to be accomplished:

1. Develop descriptions and assessments of common water quality models/methodologies used for analyzing potential impacts of transportation projects.
2. Determine which models are now out-dated, which are still valid and are best suited for detailed project level NEPA analyses.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours** 800 Total

1. Review commonly used water quality analysis methodologies and recommend which methods are best suited for project level NEPA analyses.
2. Document which models/methodologies are out-dated and which are still valid
3. Describe benefits and limitations of each model/method.
4. Outline which methods/models are endorsed by federal agencies.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Task 1: Review commonly used water quality analysis methodologies and recommend and which methods are best suited for project level NEPA analyses.	Duration - 2 months
Task 2: Document which models/methodologies are out-dated and which are still valid	Duration - 2 months
Task 3: Describe benefits and limitations of each model/method.	Duration - 2 months
Task 4: Outline which methods/models are endorsed by federal agencies.	Duration - 2 months
UDOT Review	Duration - 1 month

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverable would consist of a guidance document that summarizes the findings from all project tasks and proposed recommendations

8. Describe how will this project be implemented at UDOT.

UDOT Staff and consultants will use this product as they prepare the water quality sections of Environmental Assessments (EAs) and Environmental Impact Statements (EISs)

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

We will be able to more accurately assess water quality impacts from transportation projects. Given the results of this study, we will be able to target harmful pollutants and develop effective BMPs to minimize potential adverse impacts from storm water runoff.

10. Describe the expected risks, obstacles, and strategies to overcome these.

None

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Jerry Chaney, UDOT Environmental Services

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$80,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Greg Punske	FHWA	
B) Mike Fazio	UDOT Central Hydraulics	
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

State of Utah – Division of Water Quality

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Elk Crossing Design

No.: 06.04-02

Submitted By: Paul West

E-mail: paulwest@utah.gov

1. Briefly describe the problem to be addressed:

Vehicle accidents with elk is becoming an increasingly important issue on Utah's highways and freeways. Generally, elk do not use wildlife crossings as readily as do deer and other wildlife. A lot of research has been done with regard to the design of highway crossings for deer, and some other animals, but little has been done for elk. Some research has been done by the Arizona DOT, and it appears that elk do not readily use box, or arch culverts, or even bridges with vertical, concrete, or SME walls.

Optimal openness indices of highway underpasses have been developed for deer, but again, little, if any, research has been done to determine whether openness is a consideration for elk.

This research will determine optimal design and openness of highway crossings for elk as well as their proper placement in the landscape.

2. List the research objective(s) to be accomplished:

1. Optimal design of highway crossings for elk
2. Optimal openness index for elk underpasses
3. Proper location of elk crossings in their natural landscape

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|--|-----|
| 1. Literature search of technical papers regarding highway crossings for elk. | 40 |
| 2. Monitoring five existing wildlife underpasses of different designs, in known elk migration routes during spring and fall migration. | 350 |
| 3. Data compilation and analysis | 300 |
| 4. Report | 40 |
| 5. | |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This effort should begin with the Fall migration. Monitoring can be done with infrared cameras, activated by laser beams whenever elk (or other wildlife) cross the beam.

Five known wildlife underpasses of differing design and size in known elk migration routes should be monitored through Fall and Spring migration seasons.

Data will be compiled and analyzed for elk willingness to use these underpasses, to determine which kind of underpass and size they prefer.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
 Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A report suggesting optimal design and size of structure elk are most willing to use to cross under highways and freeways.

8. Describe how will this project be implemented at UDOT.

Design and size criteria will be given to design engineers and structural engineers to use when designing future wildlife crossings in elk migration routes.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This report should aid in reducing vehicle/elk accidents on some of Utah's busiest highways, such as U.S. 6

10. Describe the expected risks, obstacles, and strategies to overcome these.

The main risk is that the study will not be comprehensive enough. Much more research will likely be needed in the future.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Paul West, UDOT Wildlife Biologist

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): Estimate \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Paul West	Utah Department of Transportation	801 965-4672
B) Ashley Green	Utah Division of Wildlife Resources	801 491-5654
C) Doug Sakaguchi	Utah Division of Wildlife Resources	801 491-5678
D) Bruce Bonebrake	Utah Division of Wildlife Resources	435 865-6100
E) Mike Canning	Utah Division of Wildlife Resources	801 538-4716
F) Larry Crist	U.S. Fish and Wildlife Service	801 975-3330
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

U.S. Forest Service, U.S. Bureau of Land Management, Rocky Mountain Elk Foundation

RESEARCH PROBLEM STATEMENT

Problem Title: Assess detention basin design and operation to determine water quality benefits, evaluate potential modifications to enhance water quality benefits **No.: 06.04-03**

Submitted By: Karen Nichols, Stantec Consulting

E-mail: knichols@stantec.com

1. Briefly describe the problem to be addressed:

Goup 4. Hydraulics and Environmental

Current design criteria for stormwater detention basins are based on water quantity requirements. UPDES discharge permits require the implementation of best management practices to reduce the discharge of pollutants to the maximum extent practicable. Existing basins and future basins can be physically modified to provide additional water quality benefits. An investigation to determine removal efficiency of suspended solids and other pollutants associated with urban stormwater discharges from transportation corridors for existing and modified detention basins would support regulatory requirements, for the UDOT UPDES Phase 1 Stormwater Discharge Permit (UTR0000003) Post Construction Controls (). An assessment of operation and maintenance requirements for existing basins and modified basins would be conducted to determine maintenance schedules and disposal of sediment requirements.

2. List the research objective(s) to be accomplished:

1. Literature search on water quality benefits for stormwater pollutants of concern of detention basins.
2. Review of design criteria for future stormwater detention basins and establishment of modification criteria for existing stormwater detention basins.
3. Establishment of operations and maintenance schedules for existing basins and modified basins.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours: 600 –800 hours

1. Conduct literature search to determine stormwater pollutants of concern and their characteristics.
2. Review and establish design criteria for stormwater quantity and quality for future stormwater detention basins and potential modification to existing stormwater basins, to predict water quality benefits in accordance with post construction water quality controls requirements of the UPDES discharge permit.
3. Coordinate with State Division of Water Quality, stormwater and design sections, during the development of the criteria. Coordinate with UDOT legal, environmental, hydraulics and maintenance for design and implementation strategies to meet regulatory requirements.
4. Establish design procedures for future stormwater basin designs in compliance with water quality and water quantity requirements.
5. Conduct a detailed review of one UDOT transportation drainage basin, gather topographic data to evaluate capacity and hydraulic characteristics of existing basin, prepare conceptual design drawings for water quality benefit modifications. Prepare stormwater sampling plan and conduct water quality samples of existing basin, during two storm events, inflow and outfall, to assess actual water quality benefits of the existing basin.

The study is estimated at 600 hours, with an additional 200 hours for stormwater sampling....

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project would need to last at least 9 months to a year and span over spring or fall, in order to collect actual stormwater samples. Begin in Fall 06 and end in Spring 07.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative : ☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant, UDOT Staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Design method to incorporate water quality benefits, as well as meet water quantity discharge requirements. Documented design procedures with predictive pollutant removal efficiencies will assist the designers' meet environmental requirements.

8. Describe how will this project be implemented at UDOT.

During the design process, if storm water quality is a concern and a structural control is required, the evaluation of detention basins, prediction of sediment removal efficiencies and other pollutant removal efficiencies would be required. This process will assist the designers with criteria and procedures to design detention basins to serve as both water quantity controls and water quality benefits. This process will also outline and predict maintenance frequency and procedures for the detention basins.

If an existing stormwater facility is required to be modified to enhance water quality discharges, procedures for the design of the modification will be prepared to assist the designers.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The benefit of this project, is that the designers will understand the environmental criteria associated with stormwater discharges as well as the design criteria to produce a design that meets: 1) environmental criteria and permit conditions; 2) water quantity discharge requirements; and 3) minimum operation and maintenance requirements.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No risk is expected. Coordination between environmental, hydraulics and maintenance will assist with implementation.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Hydraulics—Denis Stuhff; Environmental –Jerry Chaney; Maintenance—Lynn Bernhard

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$50,000- \$75,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A)			
B) Tom Rushing	DWQ	538-6146	NO
C) Dennis Stuhff	UDOT Hydraulics	965-4224	Yes
D) Jerry Chaney	UDOT Environmental	965-4317	Yes
E) Lynn Bernhard	UDOT Region 2 Maintenance		Yes
F) Marwan Farah	UDOT Region 2		Yes
G) Mike Fazio	UDOT Hydraulics		Yes

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah Division of Water Quality, Salt Lake County Engineering Division (provide stormwater sampling equipment, and assistance during sampling plan preparation)

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Fish Passage at Utah Culverts: Strategy, Assessment, and Design

No.:06.04-5

(see also 06.09-1)

Submitted By: Rollin H. Hotchkiss, Ph.D., P.E., D.WRE and Mark Belk,
Ph.D., Brigham Young University

E-mail: rhh@byu.edu

1. Briefly describe the problem to be addressed:

There appears to be no Agency strategy or pilot database in place to guide assessment of aquatic organism passage, or even fish passage, at UDOT culverts, nor does there appear to be a design procedure in place for this objective. State Departments of Transportation are becoming more involved in providing passage for aquatic organisms (amphibians and fishes) at culverts in response to endangered species listings, other agencies' initiatives, and the desire to restore ecosystem connectivity to watercourses. UDOT is responsible for approximately 61,000 culverts, but aquatic organism and fish passage is currently addressed only on an as-needed basis, sometimes resulting in unanticipated consequences. For example, a recent culvert replacement project in Logan Canyon resulted in the elimination of all fish of interest upstream from the culvert because the design specification of using a corrugated metal pipe culvert was changed to a plastic pipe in the field. The smooth interior increased velocities so much that fish could not pass upstream. An assessment strategy and design procedure for aquatic organism or fish passage at UDOT culverts is needed.

2. List the research objective(s) to be accomplished:

1. Develop a strategy for prioritizing culverts for aquatic organism or fish passage
2. Determine an appropriate assessment protocol for Utah and test it in the field
3. Create a pilot database of assessment for UDOT to build upon based upon the results from Objective 2
4. Develop a design procedure that allows for aquatic organism or fish passage through culverts.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Meet with relevant Federal and State Resource agencies to strategize a culvert assessment prioritization scheme – **40 hours**
2. Using the prioritization scheme, identify the most urgent regions within the UDOT system for culvert assessment – **800 hours**
3. Review current assessment protocols and design procedures for potential implementation in Utah. Dr. Hotchkiss is compiling such protocols and procedures as part of a current FHWA-funded project on the design of bridges and culverts for fish passage – **80 hours**
4. Use the candidate protocol(s) on a representative sample of culverts and field verify assessment accuracy by performing fish counts – **1100 hrs**
5. Develop a GIS database of results and assessment outcomes – **500 hours**
6. Develop a draft procedure for the design of culverts for aquatic organism and/or fish passage – **280 hours**
7. Write a project report documenting results and recommending future actions; develop and provide training to UDOT personnel – **300 hrs**

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The project will require 18 months. Tasks 1-3 will be completed within 5 months. The field campaign (Task 4) will take seven months and will require a summer sampling season to assure access to the selected culverts. Two months will be needed to develop the database and draft a design procedure (Tasks 5 and 6), and four months are allowed for review of the draft and final reports.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
 Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University in collaboration with UDOT and relevant agencies

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. A project report documenting all work
2. A GIS database of culvert assessments for use in the future and a draft design procedure for culvert design for aquatic organism or fish passage
3. Training for UDOT employees in use of assessment protocols, database construction, and culvert design

8. Describe how will this project be implemented at UDOT.

Task 4, performing field assessments, will be done with as much participation from UDOT personnel as their time and budget will allow. This will enable them to become familiar with the techniques that they can use in the future. Near the end of the project, a formal training program will be provided to all interested employees of UDOT and other agencies for culvert assessment and design. The pilot database of assessments will be maintained and grown as UDOT personnel continue the process of culvert assessment in the future.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT staff will have knowledge on how to continue the assessment program in the future. The culvert assessments can be used to prioritize fish and/or aquatic organism-friendly culvert replacements or retrofits. This strategy will save time and money. Other Federal and State Resource agencies can coordinate culvert replacements with UDOT, providing stream connectivity within a watershed that has multiple agency jurisdictions. The draft design procedure will provide UDOT hydraulic engineers a tool for specifying new culverts that will pass aquatic organisms and/or fish. Finally, the citizens of Utah will benefit from a long-term sustained fish and aquatic organism populations.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Potential Obstacle

- Interagency disagreement on priorities for assessment
- Extreme weather (flood or drought) that would make access to candidate culverts impossible

Overcoming the Potential Obstacle

- Meetings early and often in the project; interagency review of work
- Be prepared to re-align the field sampling program as needed

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Michael Fazio, Brent Jensen, and Denis Stuhff

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$74,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Tom Chart	Senior Fisheries Biologist, U.S. Fish and Wildlife Service	801-975-3330
B) Don Wiley	Fisheries Biologist, Utah Division of Wildlife Resources, Central Region	801-491-5678
C) Kris Buelow	JSRIP Local Recovery Program Coordinator, Central Utah Water Conservancy District	801 226-7132
D) Dan Duffield	Regional Fish Program Manager, U.S. Forest Service	801-625-5662
E)		
F)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

CUP Completion Office, Utah Department of Natural Resources Species Recovery Program, Utah Reclamation Mitigation and Conservation Commission, Federal Highway Administration

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Plan for Every Section- Safety Information

No.:06.05-1
(also see 06.03-1)

Submitted By: Doug Anderson

E-mail: dianderson@utah.gov

1. Briefly describe the problem to be addressed:

Safety related information is crucial when making decisions related to roadway improvements and preservation. The Plan for Every Section maintained by the region staff could benefit from data and information related to the safety aspects of each section. Information from various databases within UDOT could be listed in a common report that would summarize the safety needs of each section. As activities are planned within highway sections. These databases include CARS (Traffic & Safety), Pavement Condition (Planning), Features Inventory (Maintenance), and Bridge Inventory (Structures Division) and the HPMS system.

Information that may be included in the reports are: skid index, rut depths, roughness, edge drop-offs, slope flattening needs, drainage problems, rumble strip requirements, deer fence deficiencies, school zone problems, fatigue related crashes, sharp curve issues, narrow bridge problems, black ice on bridge decks, obscured vision due to trees or weeds, and the need for curb, cutter or sidewalks and points of access.

2. List the research objective(s) to be accomplished:

1. Identify what information is needed by the decision-makers that use the Plan for Every Section.
2. Deliver the information to the users in a format that is easily understood and applied to our projects and programs.
3. Create the needed reports and tables needed by the users.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours: 120 UDOT + 330 Consultant=450 hrs

1. Determine what safety related information is needed by the decision-makers using the Plan for Every Section.
2. Design a reporting system that is easily queried, and downloaded. The report format should be as simple or complex as needed by the user.
3. Hire a consultant capable of accessing the needed database and formatting a requested report.
4. Release a beta version of the system for review and comments.
5. Train all users on how to access and interpret the information.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Should be completed by July 1, 2007.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

In-house and software consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Software to create the reports, a Users Manual, a training module, and a report describing the project.

8. Describe how will this project be implemented at UDOT.

Training will be conducted, Users Manuals distributed, software submitted to the PM staff, and reports added to each section plan.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The reports should be useful for 10 years or longer. Users will include Maintenance Engineers, PM Engineers, Maintenance personnel, Safety Coordinators, Project Managers, and designers.

10. Describe the expected risks, obstacles, and strategies to overcome these.

There are problems when information from various databases is extracted for use. Users will need to have a basic understanding of how to interpret the information contained in the reports.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Dave Blake and Traffic & Safety staff, region staff responsible for projects and programs within the roadway.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Doug Anderson		
B) Dave Blake		
C) Robert Clayton		
D) Glen Ames		
E) Ed Rock		
F) Bill Lawrence		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

MPOs could benefit from the information. Some city and county governments could use the information. Enforcement agencies could use the data if we choose to include information such as DUI related crashes, speed related accidents, truck crashes, etc.

2006 RESEARCH PROBLEM STATEMENT

Problem Title:

Cross-Asset Analysis: fair comparison among asset classes

No.:06.05-2

Submitted By: Glen Ames

E-mail: glenames@utah.gov

1. Briefly describe the problem to be addressed:

UDOT is currently able to perform a cross-asset analysis where benefit-cost ratios are calculated and projects are recommended from the software. However, we must re-examine how we are calculating and comparing the benefits of a bridge project vs. a pavement project. We must ensure that the scale is not tipped too far in favor of one or the other so that the results of the analysis can have good integrity.

Strategic Goal:



Preservation



Operation



Capacity



Safety

(Check all that apply)

2. List the research objective(s) to be accomplished:

1. Document the methodology of calculating and comparing benefit/cost ratios that are fair and balanced among various asset classes such as pavement, bridges and maintenance.
2. Together with Deighton Associates, document how to implement the changes within dTIMS-CT Enterprise

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours: 400 hours

1. Examine how UDOT is currently performing the cross asset analysis, including how the benefit/cost ratios are calculated and compared (40 hours)
2. Research what other transportation agencies in the world are doing in the area of cross-asset analysis and how they are comparing benefits between different asset classes. (40 hours)
3. Develop and recommend a better way of calculating/comparing the benefit/cost ratios between various asset classes (80 hours)
4. Create a document describing the process of comparing the benefit/cost ratios between various asset classes and how to implement this in dTIMS-CT (work with Deighton Associates on the dTIMS-CT portion). (40 hours)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Aug 2006 – Sep 2006: Step 1 and 2

Oct 2006 – Nov 2006: Step 3

Dec 2006: Step 4

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University, but will need to work with the consultant from Deighton Associates

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A document describing the process of comparing the benefit/cost ratios between various asset classes and how to implement this in dTIMS-CT (work with Deighton Associates on the dTIMS-CT portion).

8. Describe how will this project be implemented at UDOT.

The recommended methodology from the project will be incorporated into the model used within the dTIMS-CT software.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will have a better way to compare the benefit/cost ratios among asset classes, which will give the Asset Management System more integrity and repeatability.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Recommendations must be approved by TRANSMAT

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Glen Ames, Asset Management Engineer

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): 200 hrs x \$100/hr = \$20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Glen Ames	UDOT	965-4953
B) Jeff Zavitski	Deighton Associates	905-697-2644
C) TRANSMAT	UDOT	965-4000
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: UDOT Database Integration

No.: 06-05.3

1. Briefly describe the problem to be addressed:

The Department has several differing databases that collect and store a lot of the same information. This collection and storage of data should be merged into one database.

Strategic Goal: ☒ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. An independent study to look at the databases in use and being developed.
2. Determine those that collect and store the same information.
3. Recommendation on how to merge, store and access the information.
- 4.
- 5.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Obtain a list and complete a review of Department databases. (40hrs)
2. Determine common information. (120 hrs)
3. Study and recommend how to merge, store and access the information. (120 hrs)
- 4.
- 5.
- 6.
- 7.
4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.)

☒ Improved asset ☐ Crashes reduced ☐ Environmental benefit ☒ Enhanced efficiency ☐ Other

Long term implementation based on recommendations of the study.

(Please fill out other side of sheet as well.)

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Useable report with recommendations.

6. Who in the Department could be the direct end-users of this study's results?

All who manage and use databases. ISS Department.

7. How could the Department benefit from implementing the results of this study?

It will give the Department an outside opinion and direction regarding database collection and storage. It will give the Department an overall view of what effort will be required and what is possible in migrating and merging duplicate information currently in differing databases.

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20,000

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Gary Kuhl	UDOT/Program Development/Complex	964-4552	Yes
B) Bill Lawrence	UDOT/Program Development/Complex	965-4560	Yes
C) Michelle Verucchi	UDOT/Program Development/Complex	965-4490	?
D)			
E)			
F)			
G)			

10. Identify other Utah agencies or groups that may have an interest in supporting this study:

☐ City ☐ County ☐ MPO ☐ Research Organization ☐ Private Industry ☐ University ☐ Other

List names:

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

☐ FHWA ☐ USGS ☐ EPA ☐ NCHRP ☐ TCRP ☐ State DOT=s ☐ Other

List names:

RESEARCH PROBLEM STATEMENT

Problem Title: PRIORITIZATION OF BICYCLE AND PEDESTRIAN IMPROVEMENTS

No.: 06-05.4

1. Briefly describe the problem to be addressed:

Interest has been growing for several years, at UDOT, among local communities, and with the public at large, in providing new facilities to safely accommodate bicycles and pedestrians along state highway corridors. The interest is driven by a desire to improve safety, increase bicycle tourism opportunities, facilitate healthy activity for residents, and potentially slow growth in the demand for automobile travel. SAFETEA-LU has mandated the Safe Routes to School program. To address these needs, UDOT has added specific bike and pedestrian information to its Manual of Instructions and the Preconstruction design checklist. Much progress has been made at the project-implementation level, but there is still much to be done at the strategic level of planning and project selection.

While UDOT has large volumes of data on motor vehicle usage available for its roadway project selection process, very little exists for bicycle or pedestrian usage, beyond some crash statistics. Within the past year, UDOT has begun collecting some bike and pedestrian counts, (one was completed last year in Cedar City and three more are planned for 2006 in Sandy, Logan, and at Parley's Crossing) but we still need a prioritization procedure. A small, but significant amount of funding is available each year for bicycle- and pedestrian-related improvements. As popularity grows, additional funds may also become available. A systematic, cost-effective process is needed to determine the location of needed improvements statewide and to prioritize needs on long-term and annual bases so these funds may be used in the most effective manner. Such a procedure would also be very helpful if additional funds were to be identified from federal, state, local, or private sources.

Strategic Goal: **Safety** (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Recommend a procedure for identifying bicycle and pedestrian needs statewide and prioritizing projects to meet those needs over the period covered in the UDOT long-range transportation plan. Include recommendations on data type and amount to be collected and on cost-effective collection techniques.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Literature search and other research to determine what other states, metropolitan planning organizations, and cities are using to assess their bicycle/pedestrian facility needs and how they prioritize spending on those facilities.
2. Evaluate the various data collection/analysis tools available and make recommendation on what UDOT should use.
3. Determine if it is appropriate to use some kind of warrant for each facility. If so, recommend a warrant analysis.
4. Recommend a procedure to prioritize the implementation of improvements to the state highway system to address bike and pedestrian needs, so that a financially responsible project-based long-range pedestrian and bicycle plan may be developed.
5. Identify stakeholders and potential funding sources for these improvements.

4. How will this project be implemented? (e.g. training, equipment, software, hardware, field demos, workshops, etc.)

The developed procedure would be used annually to prioritize corridors for addition/upgrade of sidewalks, ped overpasses, bike lanes, widened shoulders, etc. It would also be used in preparing a true long range plan for pedestrian and bicycle facilities on and parallel to the state highway system, focusing on the areas of greatest safety need, highest current and latent demand, and other pertinent factors. This will be a cooperative effort. Maximum 1-yr study.

5. What deliverable(s) would you like to see? (e.g. useable technical product, technique, policy, procedure, specification, standard, software, training tool, etc.)

Procedure for identifying and prioritizing bicycle and pedestrian needs associated with the state transportation system.

6. Who in the Department could be the direct end-users of this study's results?

Planning, Project Development, Region Preconstruction, Region Construction

7. How could the Department benefit from implementing the results of this study?

The new procedure derived from the study would allow UDOT to plan and program projects to serve pedestrian and bicycle need and to do so in a logical, systematic, and repeatable fashion.

8. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20K

9. List the potential champions (people interested in and/or willing to participate in the Technical Advisory Committee for this study):

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Kevin Nichol	UDOT Planning	965-3853	Y
B) Sharon Briggs	UDOT Planning	964-4564	N
C) Todd Hadden	UDOT Systems Planning & Programming		Y
D) Michael 'Kaz' Kaczorowski	UDOT Planning		Y
E) Jory Johner	WFRC		N
F) Jim Price	Mountainland Assn of Governments		N
G) Theron Jeppson	UDOH – Bike/Ped		N
H) Roland Stanger	FHWA		
I) Stakeholder Rep	Biking Industry		

10. Identify other Utah agencies or groups that may have an interest in supporting this study:

Alliance for Cardiovascular Health – UDOH
 Utah Division of Parks & Recreation
 Salt Lake Mayor's Bicycle Advisory Committee (MBAC)
 Salt Lake County Bicycle Advisory Committee
 Weber Pathways, Provo Bicycling Committee, Utah Travel Council
 Bingham Cyclery, Bonneville Touring Club, Cache Trails Coalition, Parley's Rails, Trails and Tunnels Coalition (PRATT)
 Three Rivers Trail Foundation, Mountain Trails Foundation, Color Country Cycling Club
 Utah Transit Authority
 PTA
 Utah Bicycle Coalition

11. Identify other regional/national agencies or groups that may have an interest in supporting this study:

FHWA
 State DOT's
 USDA Forest Service
 National Park Service
 REI
 Adventure Cycling Association
 Association of Pedestrian and Bicycle Professionals
 Bikes Belong, International Walk To School, National Center for Bicycling and Walking, Walkable Communities Inc.
 America Bikes, America Walks

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Asset Tracking – (construction history)

No.: 06.05-5
(also see 06.03-2)

Submitted By: Gary Kuhl & Bill Lawrence & Mike Marz

E-mail: Gkuhl@utah.gov
Blawrence@utah.gov

1. Briefly describe the problem to be addressed:

UDOT does not have a defined process to capture information about the changes we make to our roadways. Many database systems need to be continuously updated to reflect changes made each year.

A standardized method(s) needs to be created that can be completed by anybody doing Maintenance or Construction that makes a change to the system that will capture what was done, where it was done, when it was done & how much it cost.

A more involved process needs to be developed to take this information and make it available to those database managers to update their data.

This would initially capture the data needed to update the Reference System, Plan for Every Section and Pavement Management databases, as well as the Maintenance Features Inventory and HPMS database. Changes such as adding a lane, changing the median width, placing a chip seal or overlay, and many others could all be recorded and made available from one location.

2. List the research objective(s) to be accomplished:

1. Formalize a procedure to regularly obtain the as constructed or maintenance information or changes that occur to the roadway.
2. Identify a standard regarding what information should be recorded.
3. Develop or use a current system to enter and store this data.
4. Create reporting methods that will make this information available for use in a convenient way.

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours

1. Form a UDOT QIT to identify what information is needed to update the various databases.
2. Create a form(s) to record these changes.
3. Identify who should enter this information.
4. Create a procedure(s) to follow for data entry.
5. Design a system to manage and report this information.
6. Hire a consultant capable of creating and/or updating the needed database and reporting system, or purchase some off the shelf software.
7. Test the system.
8. Train the users on how to access the system to enter and retrieve information.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Should be completed by July 1, 2007

5. Indicate type of research and / or development project this is:

☒ Research Project

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

In house staff with software consultant.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A software application to enter, manage & report the information, with links to current UDOT databases. User documentation & training. A report describing the project.

8. Describe how will this project be implemented at UDOT.

A procedure will be followed to enter changes thru a web-based form(s). As needed reports will provide database managers with updated changes to keep various databases up to date. System enhancements could automate the database updates.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

System changes will be recorded timely and accurately creating a history of what we did. Annual tracking can be automated.

10. Describe the expected risks, obstacles, and strategies to overcome these.

There needs to be consistency in data entry, both in actually doing it & in what gets recorded.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Bill Lawrence & Mike Marz

Pavement management & Planning Statistics

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Gary Kuhl	Systems Planning & Programming	
B) Bill Lawrence	Systems Planning & Programming	
C) Jerry Arnold	Systems Planning & Programming	
D) Llyod Neely	Maintenance	
E) Darrel Giannonatti	Construction	
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Other DOTs interested in managing their Assets.

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Data Management System for Systems Planning and Programming

No.: 06-05.8

Submitted By: Matthew Swapp

E-mail: mswapp@utah.gov

1. Briefly describe the problem to be addressed:

We are need of a data management system for all of the various data items collected and referred to by customers of the Systems Planning and Programming Division. The Goal of this project would be to develop a data management system to meet the needs of our division.

Strategic Goal: ☐ X Preservation ☐ X Operation ☐ X Capacity ☐ X Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Research what has been done in other states.
2. Analyze other states systems and compare to our needs
3. Develop and implement a system for use in Systems planning and Programming

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Research
2. Analysis
3. Development
4. Implementation
- 5.
- 6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

18 Month Contract

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ X Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Management System, Users Guide, Training

8. Describe how will this project be implemented at UDOT.

Approval and acceptance at various management levels

Funding, personnel , and management arranged

Project implemented and updated on a fixed schedule

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Data will be made more accessible to all customers.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Cost and manpower effort to maintain.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Matt Swapp / Kim Schvanelveldt / Ahmad Jaber

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$ 40,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Kim Schvanelveldt	Planning Section	
B) Ahmad Jaber	Systems Planning and Programming	
C) Bill Lawrence	Traffic Statistics	
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Other UDOT Region Offices and Division Offices

2006 RESEARCH PROBLEM STATEMENT

Problem Title: An Evaluation of Toll vs. HOT Lane Facilities

No.: 06-05.9

Submitted By: Grant Schultz (BYU)

E-mail: gschultz@byu.edu

1. Briefly describe the problem to be addressed:

Over the past few years UDOT has initiated a statewide study to evaluate the potential for implementing various managed lane techniques including: 1) reversible lanes, 2) high occupancy vehicle (HOV) lanes, 3) high occupancy toll (HOT) lanes, 4) fast and intertwined regular (FAIR) lanes, and 5) toll facilities. The results of this study provided the background on managed lane technologies available for consideration in the state as well as some of the issues associated with the implementation of such lanes, including Legislation to allow UDOT the ability to use managed lanes.

The purpose for this research project is to advance the concept of toll facilities in the state of Utah by comparing, contrasting, and identifying the pros and cons of regular toll lanes vs. high occupancy toll (HOT) lanes. This would include a summary and discussion of the impacts on traffic, expected revenue projections, and implementation details (i.e., what is required to manage each technique).

Strategic Goal: ☐ Preservation ☐ Operation ☒ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Prepare a summary of the state of the practice for Toll and HOT lanes.
2. Prepare a summary of the pros and cons for Toll vs. HOT lanes.
3. Identify the traffic impacts, revenue projections, and implementation details for Toll and HOT lanes.

3. List the major tasks required to accomplish the research objective(s): 12 – 18 months Estimated person-hours 1,600

1. Literature review to identify the pros and cons of the Toll facilities.
2. Survey state DOTs and research agencies that are currently using and managing Toll and HOT lanes.
3. Summarize survey results.
4. Estimate revenue projections and summarize implementation details.
5. Prepare a summary of results (research document) as well as a presentation of these results for UDOT.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Coordinate with UDOT on current Toll projects to identify critical time periods for analysis. Once these time periods have been identified, begin research project and evaluation. Anticipated timeframe 12 to 18 months.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University in consultation with Consultant on current related UDOT projects and UDOT Staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include a report outlining the comparison of Toll vs. HOT lanes and a presentation for UDOT staff summarizing the results.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT through the planning program by providing information on Toll and HOT lanes that can be utilized in corridor project evaluations.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from this project as the groundwork will be set for planning and operations to consider Toll and HOT lanes in future corridor projects.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Ahmad Jaber

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):\$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Grant Schultz	Brigham Young University	(801) 422-6332
B) Matt Swapp	UDOT Planning	
C) Russ Robertson	FHWA	
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: WFRC, MAG.

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Alternative Light wavelengths for Automated Pavement Distress Data Collection

No.: 06.05-10

Submitted By: Chris Glazier

E-mail: cglazier@utah.gov

1. Briefly describe the problem to be addressed:

High Intensity light used to illuminate pavement during automated distress data collection pose serious hazards to the surrounding drivers. The bright flashes or strong light can cause visual interference and distraction, even temporary blindness. Perhaps light spectrum beyond the visible range can easily provide the illumination required for accurate data collection an at the same time remove the potential hazard to drivers.

2. List the research objective(s) to be accomplished:

1. Acquire pavement images with multi spectral and hyper-spectral cameras.
2. Find appropriate signature wavelengths that provide data for automated distress detection
- 3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Search existing pavement publications for information
2. Search for appropriate camera functionality
3. Take sample images
4. Run test images through SmartPDA software
- 5.
- 6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

no schedule

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)? University/consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report showing wavelengths most appropriate outside visible spectrum

Make model and cost of cameras and lens

8. Describe how will this project be implemented at UDOT. When UDOT purchases upgrades to Photolog Van, new pavement image data collection technology should be incorporated.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be. Better, Faster, safer, cheaper and more accurate pavement distress data.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Perhaps No camera is suitable, perhaps no wavelength of light provides proper illumination.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Bill Lawence and Chris Glazier

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Gary Kuhl		
B Russ Scovil		
C) Doug Anderson		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: GIS Project Tracking Website

No.: 06.05-11

Submitted By: Ed Rock

E-mail: erock@utah.gov

1. Briefly describe the problem to be addressed:

One of the criticisms that UDOT receives from the public is why we don't have better coordination between our construction projects. Sometimes this happens because transportation funding is controlled by politics and we have little control over that process. However, on other occasions this criticism is valid and could be improved if we did better planning. Unfortunately, most of the tools we use in UDOT to manage preconstruction and construction projects do not allow the projects to be viewed simultaneously in a graphical view. For example ePM is a great tool but lacks a graphical way to show projects.

We need a better tool. We need to develop a tool to graphically display all UDOT projects (both preconstruction & construction projects) in a using a GIS web environment. This would allow project managers, PICS, media, local governments, contractors, and the public to view all projects and do better planning. The user could choose to view projects on a map by type or construction, year, PM, RE, etc. The map could allow the user to click on the road to go to the Project website. ACCURATE preconstruction and construction schedules could be view (i.e., when will construction be finished, when will it be advertised).

Strategic Goal:	<input type="checkbox"/> Preservation	<input checked="" type="checkbox"/> Operation	<input checked="" type="checkbox"/> Capacity	<input type="checkbox"/> Safety	(Check all that apply)
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2. List the research objective(s) to be accomplished:

1. Develop a GIS website to display all preconstruction and construction projects. The GIS website would allow users to query projects based on various criteria and then display the results on an interactive map.

2. Evaluate how much the product is being used, if it is improving how we do business, & if it is of value to our external customers and partners.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Use GIS to develop a Transportation Explorer website. (1500 hours)

2. Link GIS website to ePM and PDBS databases. This would involve an effort to clean up those databases so that it is GIS compatible. It could also require creating some new fields in ePM. (1500 hours)

3. Link map to project websites. (40 hours)

4. Provide training on how to use the system. (40 hours)

5. Evaluate how much the product is used and if it is improving our planning process. (80 hours)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

GIS Web Development – 6 months

Modify/Clean Database – 3 months

Implementation & Product Evaluation – 6 months

Report on project effectiveness.

5. Indicate type of research and / or development project this is:

Large:	<input type="checkbox"/> Research Project	<input checked="" type="checkbox"/> Development Project		
Small:	<input type="checkbox"/> Research Evaluation	<input type="checkbox"/> Experimental Feature	<input type="checkbox"/> New Product Evaluation	<input type="checkbox"/> Tech Transfer Initiative :
	<input type="checkbox"/> Other _____			

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT ETS has already started to develop a pilot version of this concept for Region Two using an AJ web developer and Chris Glazier's time. If funded, we could continue this effort and expand it Statewide by hiring AJs and involving ePM staff/resources.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
GIS Project Tracking Website (GIS ePM)

8. Describe how will this project be implemented at UDOT.

Develop the GIS Project Tracking website, train users, and allow them to use and evaluate the system.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

PMs, Preconstruction Engineers, and planning can see graphically all upcoming and current projects and make better planning decisions. It would allow these groups to show ePM and PDBS data on a map.

UDOT management (Region Directors, etc) could use the tool to keep better track of projects.

PICs, the public, local governments, and the media could use the tool to see keep track of projects and find out project status/information.

10. Describe the expected risks, obstacles, and strategies to overcome these.

1. Product goes unused or underused.

2. Clean up ePM & PDBS databases to be GIS compatible and program some features (data fields) into ePM. This will require coordination and buyoff by ePM & PDBS management.

3. Rely on PMs and others to keep the database current.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Ed Rock - ETS

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$95,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Chris Glazier	ETS - GIS	965-4381
B) Becky Stromness	ePM	964-4518
C) Joe Kammerer	Region Two Project Management	
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Consultants, AGC

2006 RESEARCH PROBLEM STATEMENT

Problem Title: 3D Photolog

No.: 06.05-12

Submitted By: Ed Rock

E-mail: erock@utah.gov

1. Briefly describe the problem to be addressed:

UDOT has an existing photolog system. The system is useful but has limited applications because the images can only be viewed in one direction and are not taken at frequent enough intervals for certain needs.

Immersive Media can provide camera system that creates a photolog movie that allows the user to pan the camera all directions (up, down, 360 degrees). The system takes 30 frames per second, so the user can see all features along the roadway. It is literally like having a 3D movie of our roadways.

The system costs \$120,000.

If we purchase this system and implement the technology, we could take our photolog system to a whole new level and increase the number of people who would use the system.

Strategic Goal: ☐ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Replace our existing photolog system by purchasing the Immersive Media 3D Photolog system.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Purchase the Immersive Media Camera system. (\$120,000)
2. Train UDOT employees how to use the system. (80 hours)
3. Purchase necessary network and computer hardware infrastructure to house the data. (\$10,000 estimated)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Purchase Immersive Media Camera System

Train existing Photolog employees how to use the system.

Begin logging state routes using new system

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Use existing UDOT Staff.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Immersive Media 3D Photolog System

8. Describe how will this project be implemented at UDOT.

Replace existing 2D photolog system

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Designers could collect existing conditions from the office. This would reduce field visits and save time. For remote design projects this time savings could be substantial. It would reduce the risk of exposure to being out in traffic to collect data. Data could be collected from a computer in the office by panning the camera.

Maintenance and operations can review existing field conditions and inventory our system from the office, saving time and exposure.

Planners could use the system to get knowledge of existing roadway system.

The 3D photolog movies of our system could be a valuable tool in the event of a natural disaster.

10. Describe the expected risks, obstacles, and strategies to overcome these.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Ed Rock - ETS

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$130,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)		
B)		
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Crash Data Mining - Safety Effectiveness of Roundabouts in Utah

No.: 06.06-1

Submitted By: Prof. Mitsuru Saito

E-mail: msaito@byu.edu

1. Briefly describe the problem to be addressed:

Since roundabouts were implemented in Utah several years have passed and they are now ready for in-depth crash analysis. In a previous study done by Prof. Saito, we focused on developing design guidelines and crash analysis was excluded due to the lack of "after" data. Now that crash data of "after" years are available and they need to be analyzed to evaluate whether roundabouts are truly effective in reducing frequency and severity of crashes at intersections. A NCHRP 3-65 "Roundabouts in the United States" is scheduled to be completed in February this year and new nationwide data set and crash analysis models will be available. This study takes advantage of the new findings for the NCHRP study and compares how the roundabouts in Utah are performing in safety improvement.

2. List the research objective(s) to be accomplished:

1. Evaluate the effectiveness of roundabouts in crash reduction
2. Compare Utah's crash data with the nationwide data and evaluate their crash reduction models

3. List the major tasks required to accomplish the research objective(s): Estimated person-hours: 800 hrs

1. Literature search on safety improvement by roundabouts, especially NCHRP 3-65 report
2. Collect crash records, before and after installation of roundabouts in Utah
3. Conduct statistical analysis and develop prediction models and compare the results with NCHRP 3-65 data
4. Evaluate safety effectiveness of roundabouts
5. Write a final report

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Start in June 2006, Complete in April 2006

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)? University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A final report discussing safety effectiveness of roundabouts

8. Describe how will this project be implemented at UDOT.

Use as a reference for evaluating future roundabouts.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Additional information on selection of roundabouts. The final beneficiaries are the public.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No risks.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Robert Hull

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Doug Anderson	UDOT R&D	801-965-4377
B) Rob Clayton	T & S	
C) John Leonard	T&S	
D)		
E)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Utah cities and counties

2006 RESEARCH PROBLEM STATEMENT

Problem Title: An Analysis of Median Crossover Crashes in Utah

No.: 06.06-4

Submitted By: Rob Clayton (UDOT) and Grant Schultz (BYU)

E-mail: robertclayton@utah.gov gschultz@byu.edu

1. Briefly describe the problem to be addressed:

The purpose of this project is to evaluate median crossover crashes on the interstate freeway system in the state of Utah. Specifically, this project will evaluate crossover crash rates at interchange vs. non-interchange locations. It is theorized that crossover crashes on interstate facilities are higher at interchange locations when compared to non-interchange locations. Initial review of 10 years of data has indicated that there does seem to be a propensity for the rate to increase at interchanges. There is a need, therefore, to evaluate this topic in more detail to identify if a problem does exist and to identify mitigation factors to address this issue if the rates are, in fact, significantly higher at one location over another.

Strategic Goal: ☒ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Evaluate crash rates at interchange vs. non-interchange locations in Utah to determine if rates are higher at one location vs. another.
2. Review research in other states to determine if others have found this to be true (the state of Florida, for example, has implemented a policy to install concrete barriers for ½ mile before and after every interchange as a result of research conducted in that state).
3. Identify contributing factors to the differences observed.
4. Make recommendations on mitigation measures to aid in reducing trends observed.

3. List the major tasks required to accomplish the research objective(s): 12 months **Estimated person-hours 1,200**

1. Literature review on safety at interchange vs. non-interchange locations.
2. Data collection on the interstate system within the state at interchange and non-interchange locations for both rural and urban settings.
3. Evaluate the data collected to establish trends in crash data. Assuming that rates are higher at interchange locations, identify why it is happening (e.g., merge/diverge, fatigue); where it is happening (e.g., rural/urban, upstream/downstream); and when it is happening (e.g., day/ night, rain/snow, etc.).
4. Compare Utah results with data collected in the literature review for other states.
5. Identify mitigation factors and make recommendations for improvement.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is recommended that this project begin in late Fall 2006, early Winter 2007 with the literature review and data collection and carry through the summer of 2007 with recommendations.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include a report outlining the literature review, data collection, and evaluation results and conclusions. From the report produced, mitigation measures would be recommended (assuming a problem is identified) along with recommendations for monitoring of the mitigation measures.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT through the Traffic & Safety Division. This research will help UDOT Traffic & Safety to identify high crash locations in and around interchanges and to establish a plan to address these issues.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from this project through an increase in safety at possible high crash locations.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Robert Clayton, Traffic & Safety (801) 965-4521

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Grant Schultz	Brigham Young University	(801) 422-6332
B) Robert Hull	UDOT Traffic & Safety	(801) 965-4273
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
TRB, NCHRP, ITE

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Traffic Impact Analysis Training (Permitting, Safety, Design)

No.: 06.06-5

Submitted By: Tim Boschert (UDOT) and Grant Schultz (BYU)

E-mail: tboschert@utah.gov gschultz@byu.edu

1. Briefly describe the problem to be addressed:

The purpose of this project is to develop a training process to supplement and aid in the effective implementation of a unified statewide traffic impact analysis (TIA) process as part of Utah Administrative Rule, R930-6. Educational materials would be established and taken from Region to Region to train UDOT personnel, local area government officials, local area Consultants and Developers, and other interested parties on the benefits and process of performing and analyzing traffic impacts of proposed developments. The training would help these individuals to follow the guidelines in Utah Administrative Rule, R930-6, relating to access management, design, and operations. In conjunction with the development of the training process and materials, all end users would be invited to suggest input to the process and training guide. Internal training would be developed first, followed by secondary education for the end users of the process.

The purpose for this training is to educate and inform all parties on the importance of TIAs as they are an integral part of the development of safe and efficient transportation systems. It is critical that the state of Utah be at the forefront in developing long-term preservation of businesses, access, and safety of the traveling public. TIAs play an integral part in this process and must be understood by all interested parties to be effective.

Strategic Goal: ☒ Preservation ☒ Operation ☒ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Development of a training analysis process to help users and customers understand the process and role of traffic analysis.
2. Train Region personnel and external users on the proper use of the TIA guidelines and the importance of TIAs in this process.
3. Provide additional guidance to Region Traffic Engineers, Permits Officers, Project Managers, Designers, and Consultants to ensure consistency statewide.

3. List the major tasks required to accomplish the research objective(s): 18 months **Estimated person-hours 1,600**

1. Literature review and focus groups to establish the state of the practice on TIA training, evaluation, and implementation.
2. Identify key concepts from the access management process to form the basis of the training program.
3. Develop training materials for both TIA guidelines and process and analysis of the studies.
4. Provide materials for a self contained training tool as well as a regular rotation for future training statewide.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is recommended that this project begin in late Fall 2006, early Winter 2007 with the development of the training materials. A draft training module would be unveiled by late Spring 2007 and the training program established for the Summer of 2007. Training would be undertaken during the summer months with feedback provided and recommendation made on future training.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and UDOT Staff joint participation with input from focus groups comprised of the end users (UDOT and other participants).

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

The deliverables expected from this project would include: 1) a process and manual for performing and analyzing TIAs, 2) a set policy for training to ensure appropriate users receive the training, 3) implementation of a training process to be included in the UDOT Design Manual, and 4) establishment of a rotational process to update training and ensure consistent coverage statewide.

8. Describe how this project will be implemented at UDOT.

This project will be implemented at UDOT jointly through the Project Development and Traffic & Safety programs. The result of this development will be extremely useful in ensuring that Department personnel from all division understand the importance of a uniform analysis process and how they can benefit from the program and aid the Department in providing a safer and more efficient transportation system. Outreach and education will be necessary across several UDOT divisions: Planning, Project Development, Traffic & Safety, and Right of Way (Permitting).

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will benefit from this project in all divisions though a unified understanding and process of TIAs, their role, and the benefits that they can provide. Excepted will be an increased efficiency of performance and analysis resulting from a standardized format. Consultants will also benefit through the standardization as will local government officials and others who participate.

10. Describe the expected risks, obstacles, and strategies to overcome these.

No known risks.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Tim Boschert, UDOT Planning (801) 965-4175

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Grant Schultz	Brigham Young University	(801) 422-6332
B) Darin Duersch	UDOT Region 1 Traffic Engineer	(801) 620-1607
C) Kris Peterson	UDOT Region 2 Traffic Engineer	(801) 975-4827
D) Doug Bassett	UDOT Region 3 Traffic Engineer	(801) 227-8019
E) Troy Torgerson	UDOT Region 4 Traffic Engineer	(435) 893-4707
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

TRB Access Management Committee, NCHRP, Consultants, ITE

RESEARCH PROBLEM STATEMENT

Problem Title: Testing and Evaluation of Non-Intrusive RWIS Instruments

No.: 06.06-6

Submitted By: Ralph Patterson

E-mail: ralphpatterson@utah.gov

1. Briefly describe the problem to be addressed:

UDOT is looking for alternative methods of measuring pavement surface conditions(i.e., moisture content, temperature and chemical etc...) to the current practice of using roadway pucks. These technologies/methodologies should be less intrusive to the road surface than the ones currently employed, while supplying the same level of information presently available.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Develop a non-intrusive method for detecting pavement temperatures and eutectic points of the road way surface.
2. Develop alternatives to measuring pavement temperature and chemical content other than using roadway pucks: The intent is to determine if there is a more maintainable, less expensive, and easier to install technology that will provide the information currently provided by the RWIS-ESS puck sensors.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Literature search/Vendor interviews (40 hours)
2. Existing product testing utilizing previous deployed RWIS sites (250 hours)
3. Enhancement or development of instrumentation to satisfy the above goals (960 hours)
4. Report (10pages) on findings and recommendations for deployment of said instrumentation (40 hours)
- 5.
- 6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Spring 2005 conduct literature search and vendor interviews
 Summer 2005 Product/methodology development, purchase current technologies to be tested
 Fall 2005 Test existing technologies, continued product/methodology development
 Winter 05/06 Test products/methodologies
 Spring 2006 generate report with findings and recommendations

5. Indicate type of research and / or development project this is: Combination of Evaluation and Development

Large: ☐ Research Project ☒ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Useable instrument as well as a report on recommendations for alternative methodologies to current practice

8. Describe how will this project be implemented at UDOT.

This product/methodology will be integrated into the sensor array on existing RWIS sites

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Historically, when road rehab has been done in locations where surface pucks are located, the pucks are no longer useable and we have to install new ones. In addition we then cut into the new pavement (chip seal etc) to reinstall the pucks. A non intrusive device will let us keep the sensors longer, while leaving the integrity of the road surface intact. Both maintenance and construction will benefit from this change in procedure.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Data assimilation into the current architecture will be a challenge, since NTCIP standards for surface conditions are not fully developed

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Ralph Patterson

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$135,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Mark Parry	ITS Traffic Management Division	887-3768	
B)			
C)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: SCATS (Sidney Coordinated Adaptive Traffic System) Evaluation

No.: 06.06-7

Submitted By: David Kinnecom

E-mail: dkinnecom@utah.gov

1. Briefly describe the problem to be addressed:

A SCATS traffic adaptive traffic signal system is being installed in 12 intersections in summit County as a pilot project. The Research Division has funded the first phase of an evaluation study to determine if this technology should be used elsewhere by UDOT.

The Research Division funding was supplemented by funding from Mountain Plains Consortium. Additional funding from MPC will be available beginning July 1, 2006.

2. List the research objective(s) to be accomplished:

1. Complete evaluation of the SCATS project.

2.

3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Conduct "after" studies.

2. Compare "before" and "after" results.

3. Document change to stops, and delay.

4. Determine cost benefit.

5. Identify and document institutional and technical challenges and issues in design, construction, maintenance and operation of the system.

6.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Complete by September , 2006.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University of Utah (They have conducted first phases of the project.)

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report

8. Describe how will this project be implemented at UDOT.

The results will be used by UDOT in deciding where to use this technology in the future.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

If the SCATS technology is successful, it will be installed elsewhere and will improve operation and coordination of traffic signals. Beneficiaries are the traveling public.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Limited risk, since this is completion of the final phase of a study that is underway.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): David Kinnecom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Richard Manser	Traffic Management Division	
B) Mark Parry	Traffic Management Division	
C) Bryan Chamberlain	Traffic Management Division	
D) Mark Taylor	Traffic Management Division	
E) Dr. Peter Martin	University of Utah	
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

University of Utah, Mountain Plains Consortium

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Seismic Vulnerability and Emergency Response of UDOT Lifelines

No.: 06.06-8

Submitted By: Steven Bartlett, Peter Martin, Steve Burian

E-mail: bartlett@civil.utah.edu

1. Briefly describe the problem to be addressed:

Earthquakes pose a significant risk to UDOT's transportation infrastructure. This infrastructure is needed after a seismic event to provide emergency response, recovery and reconstruction functions. It is important that the transportation network perform these vital functions in a timely manner to reduce loss of life, property and commerce following a major earthquake.

This study proposes to focus on two key aspects: 1) seismic vulnerability of the transportation system and 2) emergency response. Risk assessment, traffic modeling and loss estimation techniques will be applied to the transportation network to determine vulnerability of the system and lifelines that most be protected, maintained or upgraded to perform emergency response and recovery functions. The results of vulnerability study will also be used to develop emergency response strategies/activities to aid in pre and post-event planning.

The study will first start in Salt Lake County and then later encompass the Urban Wasatch Front.

Strategic Goal: ☐ Preservation ☒ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Assess the seismic vulnerability of UDOT infrastructure using a systems approach.
2. Identify and prioritize UDOT's lifeline corridors and facilities using a risk based approach
3. Help UDOT develop a plan/program to protect/maintain/improve critical lifeline corridors
4. Help UDOT develop emergency response strategies/activities to enhance emergency response and recovery.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours: 2000 to 3000

1. Apply the FHWA seismic risk assessment model to Salt Lake Valley to estimate potential earthquake damage resulting from earthquake strong motion, liquefaction, fault rupture, earthquake-induced landslides and mass movement.
2. Use UDOT traffic models to assess the disruption to the system from earthquake damage: including user and economic losses and delays results from the damage.
3. Determine the losses for a scenario earthquake (rupture of the Salt Lake City segment of the Wasatch fault) and other nearby events using risk assessment.
4. Identify key corridors and facilities that should be targeted from improvement, upgrade, or replacement.
5. Help UDOT develop emergency response activities that minimize the disruption and restore the system to a serviceable capacity and added these activities to the emergency response plan.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

One year proposed schedule for completion of Salt Lake County

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University of Utah Civil and Environmental Dept. and the U of U Traffic Lab

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Technical summary report
2. ARC GIS hazard assess,emt and traffic models
3. Implementation/Emergency Response plan for planning, traffic operations and safety.

8. Describe how this project will be implemented at UDOT.

1. Results of the study can be used for future planning and maintenance activities and funding of these activities
2. Traffic model can be used for other types of assessment (spills, floods, landslides, etc.)
3. Modifications/adaptations to UDOT's emergency response plan and activities

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

1. Reduction in seismic vulnerability and risk
2. A well-planned assessment and emergency response plan that includes realistic earthquake scenarios, damage and response to that damage.
3. Identification of key lifeline corridors and strategies to maintain, improve or upgrade these corridors.
4. A risk assessment/cost-benefit model that can be used for maintenance and planning purposes

10. Describe the expected risks, obstacles, and strategies to overcome these.

None. The proposed methods have already been developed by FHWA and the national center for earthquake engineering research. Traffic models have already been developed for the study area. This project will combine these models to develop the study and emergency response activities.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Richard Clarke, Division of Maintenance
Walter Steinvorth, Division of Planning
Shana Lindsey, Division of Research

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20k to \$30k

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Bob Carey	DPE-DES	538-3784
B) Barry Welliever	Utah Seismic Safety Commission	welliever2@eink.net
C) Gary Christenson	Utah Geologic Survey	537-3304

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

MPC

THE MPC WILL BRING MATCHING MONEY (DOLLAR PER DOLLAR) FOR THIS STUDY.

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Validation of RappidMapper, Inc.'s LD3 Software Technology

No.: 06.06-9

Submitted By: Frank Algarin, RappidMapper, Inc

E-mail:

1. Briefly describe the problem to be addressed:

RMI has been in business for over three years with a focus of bringing this technology to the point that it is ready for the market. Proven and tested we are now focused on bringing this technology to the market. This proposal is for Public Safety in concert with the Department of transportation to rent the LD3 equipment and software needed to conduct a validation and viability test of the LD3 technology.

Terrestrial LD3 Scanning captures real world conditions of data that is more accurate and more easily visualized resulting in higher confidence in analysis and presentations. The benefits of this new-generation of tools and methods will be more accurate, faster, better, cheaper and lower-risk execution of work; better quality control; high quality visualization of projects for public acceptance and better documentation of existing and interim conditions to minimize litigation risks.

2. List the research objective(s) to be accomplished:

Conduct a validation and viability test of the RappidMapper LD3 technology via the following:

- Use of LD3 Camera for Data capture of real world data.
- Providing Dimensional data with an order of magnitude greater accuracy than LIDAR.
- 3D real world photo quality scenes in LD3 file format.
- Software to view and freely navigate in the image.
- Software that allows for planning and measurement of the scene.
- Training of personnel in operation of LD3 Camera.
- Training of personnel in the use of LD3 Designer software.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

Training-RMI will provide training for Public Safety personnel on the operation of the LD3 Camera. The training will consist of:

- Camera setup.
- Camera software operation.
- Analyzing scene conditions for best capture of data i.e. weather, light conditions, etc.

RMI will provide training for Public Safety personnel on the use of the LD3 Designer software. The training will consist of:

- Navigation of virtual real world scene.
- How to acquire metric information.
- How to select information to move to a data base or CAD system.
- How to bring in 3D models for what if scenarios.

Software-LD3 Designer, The LD3 Designer software will allow the following functions:

- Allow for zoom in- out (the traditional camera directions should be used here; zoom, pan, tilt, truck) without noticeable loss of image fidelity of captured data.
- A user will be able to navigate smoothly through the scene- controlling the position, orientation, zoom, and velocity of a virtual camera moving through the scene.
- A user can save point images.
- A user with two clicks of a mouse can get the direct distance and angel between a pair of virtual marker points.
- A user with a single click of the mouse can get the global position and altitude of any point on the image
- A user can import 3DS objects.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Study will last 7 months.

5. Indicate type of research and / or development project this is:

Large:	<input checked="" type="checkbox"/> Research Project	<input type="checkbox"/> Development Project		
Small:	<input type="checkbox"/> Research Evaluation	<input type="checkbox"/> Experimental Feature	<input type="checkbox"/> New Product Evaluation	<input type="checkbox"/> Tech Transfer Initiative :
	<input type="checkbox"/> Other _____			

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

UDOT staff

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

An understanding of the effectiveness of the technology

8. Describe how will this project be implemented at UDOT.

Technology will be used to capture existing data for use in the Preconstruction process.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

More accurate data collection for use in project visualization applications in public presentations.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Higher cost and a change in the way we have done things.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

Robert Hull

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$90,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Shana Lindsey	UDOT/Director of Research	
B)		
C)		
D)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Dept. of Public Safety

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Automated Delay Estimates & other MOE's for Traffic Signals

No.: 06.06-10

Submitted By: Mark Taylor & Dave Kinnecom

E-mail: Marktaylor@utah.gov;
dkinnecom@utah.gov

1. Briefly describe the problem to be addressed:

Develop algorithm and hardware to automatically measure delay and possibly other Measures of Effectiveness (MOE's) by time-of-day, and implement the algorithm and hardware on a test basis at signalized intersections. Some of the additional MOE's may include: determining arrival percentages on green/yellow/red, vehicle occupancy, vehicle classification, and vehicle volume. Intersection approach delay and movement delay are primary MOE's to be measured.

2. List the research objective(s) to be accomplished:

1. Develop algorithm to effectively measure delay and other MOE's.
2. Determine software and hardware options to collect delay and other MOE's by time-of-day automatically.
3. Develop procedures and field test the product(s) (automated MOE's) at signalized intersections for loops, video, and radar detectors.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours (600)

1. Refine scope with TAC-technology & MOE's.
2. Develop logic to effectively and accurately measure delay and other MOE's.
3. Evaluate existing hardware capabilities and new alternatives for collecting data.
4. Develop algorithm to use automated MOE's with UDOT's detectors (inductive loops, video, and radar)
5. Develop procedures on how the automated MOE's can be installed or used in a user friendly and quick format.
6. Field Test and Calibrate the automated MOE's by comparing the automated MOE's with manually measured MOE's.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Schedule is open. We can get there by first developing the algorithms, which may be just mathematical, evaluate alternatives for collecting data, then decide how to collect the information and analyze it.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University and possibly vendors.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Algorithms, software, hardware, and procedures on how to set up automated MOE's for various different types of UDOT detectors.

8. Describe how will this project be implemented at UDOT.

Algorithm will be tested and refined. Once accepted, UDOT will decide whether to integrate into existing software packages and systems or run as a stand-alone application.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be. There are several benefits in developing automated MOE's, including: a) The ability to collect easily measured conditions in the field. Knowing what is really going on will assist UDOT in adjusting and fine-tuning traffic signal operations and making necessary geometric decisions. b) Automated MOE's will greatly assist in the calibration and validation of traffic signal models. c) Signal Operations, Traffic Engineers, and Transportation Planners will all benefit from this development.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Development of software and hardware can be risky if to complex, however, if kept simple is better. Need to brain storm and develop good algorithms.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Mark Taylor, UDOT Traffic Signal Systems Engineer

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): (600 hours) \$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)	Dave Kinnecom, Traffic Operations Center	887-3707
B)	Bryan Chamberlain, Traffic Operations Center	887-3723
C)	Chris Siavrakas, Traffic Operations Center	887-3620
D)	Professor Mitsuru Saito, Brigham Young University	422-6326
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: Cities, Counties who operate traffic signals. UDOT planning and consultants who develop traffic models.

RESEARCH PROBLEM STATEMENT

Problem Title:	Highway Advisory Radio – Evaluation, Standardization, & Innovation	No.: 06.06-11
Submitted By:	Chris Siavrakas - TOC	E-mail: csiavrakas@utah.gov

1. Briefly describe the problem to be addressed:

Highway Advisory Radio is gaining new momentum as a tool to deliver complex information about Incidents, Special Events, and Construction information to the traveling public. As we look to expand the utilization of HAR, we need to understand how the future of Radio Communication is changing with technology. We also need a better understanding of the limitations of HAR, with current technology. One of the most difficult aspects of HAR is understanding its effectiveness. Without administering costly roadside polls, it is difficult to adequately summarize both quantitatively and qualitatively the user benefit of HAR.

Strategic Goal:	<input type="checkbox"/> Preservation	<input checked="" type="checkbox"/> Operation	<input checked="" type="checkbox"/> Capacity	<input checked="" type="checkbox"/> Safety	(Check all that apply)
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2. List the research objective(s) to be accomplished:

1. Evaluate Current and Emerging Technology associated to HAR
2. Establish a cost/benefit ratio for portable and permanent HAR
3. Standard Guidelines for selecting location and display to the public

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|--|-------|
| 1. Determine a cost/benefit ratio for both permanent and portable HAR applications | 200 |
| 2. Present Radio band limitations/overlaps and new technologies (Satellite Radio, In-Vehicle radio break in) | 160 |
| 3. Present best methods for alerting traffic to turn on HAR (sign/flasher design) | 160 |
| 4. Review Web-based expansion that allows the HAR message to be heard from the internet | 160 |
| 5. Prepare Draft and Final of Report – Publish | ????? |
| 6. Presentation Preparation & Presentation meeting | 120 |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Week 1-Identify Team members-delegate tasks – TAC Meeting
 Week 2-5 - Preliminary Search and compilation of other programs lessons learned –TAC meeting
 Week 6-8 – Begin specific tasks
 Week 9 – TAC meeting –progress update/stearing check
 Week 10-13 Complete Tasks
 Week 14 – Final TAC meeting
 Week 15-16 Publish Report
 Week 17 – Present Deliverables/Findings to UDOT

5. Indicate type of research and / or development project this is:

Large:	<input type="checkbox"/> Research Project	<input type="checkbox"/> Development Project	
Small:	<input checked="" type="checkbox"/> Research Evaluation	<input checked="" type="checkbox"/> Experimental Feature	<input checked="" type="checkbox"/> New Product Evaluation <input checked="" type="checkbox"/> Tech Transfer Initiative :
	<input type="checkbox"/> Other _____		

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

-HAR Design Standard

-Training/Presentation Session

-HAR Planning and Operating Guideline (not a MANUAL)

8. Describe how will this project be implemented at UDOT.

As we seek to expand user information tools, we need an evaluation of current systems and future potential trends to provide like service.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

UDOT will be able to better manage public resources to improve traffic flow quality for Incidents, Special Events, and Construction activities. Improving this feature directly effects the publics ability to make informed choices about their trip planning options.

10. Describe the expected risks, obstacles, and strategies to overcome these.

We may not be able to establish a confident cost-benefit ratio due to the strong variability of the audience. The ability of the audience to react correctly to a HAR message and to be able to measure their reaction will be challenging.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Chris Siavrakas-TOC		887-3620	
B) Sam Sherman -TOC		887-3744	
C) Bryan Chamberlain - TOC		887-3723	
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

Airports, Marinas, Parks

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Characterization of shear strength and mechanics of landslides in the Manning Canyon Shale. No.: 06.07-1

Submitted By: Francis X. Ashland, P.G., Utah Geological Survey

E-mail: francisashland@utah.gov

1. Briefly describe the problem to be addressed:

Landslides and marginal slope stability in hillslopes underlain by the Manning Canyon Shale pose a significant challenge to design of highway cuts, fills, and structures. Uncertainties exist in shear strength and mechanics (movement and deformation behavior) of landslides in the Manning Canyon Shale. Uncertainties in shear strength may be related to a combination of factors including differences in landslide displacement and degree of weathering, the presence/absence of prior tectonic deformation of the shale, sample randomness and distribution, sample moisture condition, and type of testing. Uncertainties in landslide mechanics may be related to factors such as landslide shape and geometry, pore pressure distribution, displacement-induced changes in shear-strength, deformation partitioning in a slide mass, structural complexity and internal interaction, and activity path (the change in state from active sliding to dormancy). Limit equilibrium slope-stability analyses used as a basis of design may or may not incorporate these uncertainties, and where the uncertainties are not considered, performance of engineered construction may vary from the design limits or estimated performance criteria, and/or unanticipated failures may occur.

2. List the research objective(s) to be accomplished:

1. Define the range, particularly the lower bound of the range, in shear strength of deformed clay zones in the Manning Canyon Shale.
2. Characterize the pattern of landslide deformation and movement in landslides in the shale.
3. Identify controlling factors on landslide mechanics that help bracket uncertainties.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|-----------------|
| 1. Compile and summarize existing data on shear strength and mechanics of landslides in Manning Canyon Shale, including data on landslide displacement, changes in the rate of movement, seasonal pore pressure fluctuations, and ground deformation. | 200 hours |
| 2. Measure shear strengths of remolded samples of landslide-sheared Manning Canyon Shale using ring shear testing. | 80 hours (USGS) |
| 3. Conduct detailed geologic mapping of landslide deformation, monitor landslide movement, measure profiles, construct geologic cross sections, and perform slope-stability analyses to constrain cross sections. | 320 hours |
| 4. Analyze data and prepare report. | 200 hours |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Anticipated study period: January 1 to December 31, 2007

January-March: compile shear strength and landslide mechanics data

April: prepare interim report on compiled data; install survey points for GPS surveying (landslide movement monitoring)

May-August: conduct geologic mapping, profiling, and movement monitoring; collect soil samples for shear strength testing

September-November: conduct shear strength testing (USGS, Golden, CO); final landslide movement monitoring measurements; prepare draft technical report

December: finalize report

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☒ Tech Transfer Initiative :

Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Utah Geological Survey, Geologic Hazards Program in cooperation with the U.S. Geological Survey, Landslide Hazards Program

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
 Deliverable is a final technical report summarizing results that includes tabulated shear strength data, detailed landslide deformation maps, landslide movement plots, and seasonal pore pressure plots.

8. Describe how will this project be implemented at UDOT.

Report will be a supplemental document to assist the Geotechnical Division with design review for ongoing construction projects and possible reference document for future repair and landslide stabilization projects.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Report will provide basis for more realistic and cost-effective design, repair, and stabilization options as well as a basis for estimating design performance.

10. Describe the expected risks, obstacles, and strategies to overcome these. Documented slow movement rates in some landslides in the Manning Canyon Shale may preclude detection of movement over the short duration of the study period. Continued monitoring by the UGS in these areas beyond the study period may provide data on movement, but would not be documented in the final technical report. Sample availability is in part a function of drilling and exposures made by others in construction projects (Provo Canyon) and in other excavations. Sheared Manning Canyon Shale has been recently exposed in some 2005 landslides (such as the Sage Vista Lane landslide, Cedar Hills).

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Leslie Heppler (Geotechnical Division)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20,000 (UTRAC amount) plus (\$12,700 UGS Cost share) – approx 60/40 cost share

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Gary Christenson	Utah Geological Survey	537-3304
B) Rex Baum	U.S. Geological Survey, Landslide Hazards Program	(303) 273-8610
C) Daniel Horns	Utah Valley State College	863-8582
D) Darin Sjoblom	Utah Department of Transportation	964-4474
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: U.S. Geological Survey, Landslide Hazards Program; Utah Division of Emergency Services

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Assessment of impacts to infrastructure along State Routes 167 and 226 due to landslides in the Norwood Tuff. **No.:** 06.07-2

Submitted By: Francis X. Ashland, P.G., Utah Geological Survey

E-mail: francisashland@utah.gov

1. Briefly describe the problem to be addressed:

Landslides continue to impact State Routes 167 and 226 and associated infrastructure in western Morgan County and southeastern Weber County. Impacts include damage to highway pavement, cut slopes, drainage ditches, and buried utilities (Questar Gas). State Route 226 (Snowbasin Road) crosses two large landslides, the Bear Wallow and Green Pond slides, that remain recurrently active despite mitigation to reduce the impacts on the highway. Since 2001, numerous landslides have formed along north-facing cut slopes, some of which have required local stabilization (buttresses). Landslides along State Route 167 (Trappers Loop Road) include slides in cut slopes and slides below embankments. A 2004 slide that forced the relocation of a Questar Gas line, reactivated and enlarged in size in 2005. Upslope enlargement of the landslide encroaches on the toe of a south-facing highway embankment. Whereas ongoing landsliding poses a continuing challenge for maintenance of the two highways as well as a potential safety hazard to the public, it also is an opportunity to examine landslide mechanics and processes in the Norwood Tuff, perhaps one of the weakest geologic units in Utah. The new data and information will support future design of inevitable repairs to the highways and their infrastructure.

2. List the research objective(s) to be accomplished:

1. Define the lower bound of the range in shear strength of deformed clay zones in the Norwood Tuff.
2. Characterize the impacts to cut slopes and associated infrastructure in the Norwood Tuff by continuing landsliding and associated erosion.
3. Identify controlling factors (climatic, deformational, and hydrologic) on landslide mechanics that can be used to forecast future impacts on the highways.
4. Examine the process of landslide enlargement in the Norwood Tuff to define possible impacts to the highways.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|-----------------|
| 1. Measure shear strengths of remolded samples of landslide-sheared Norwood Tuff using ring shear testing. | 80 hours (USGS) |
| 2. Conduct detailed geologic mapping of landslide deformation, monitor landslide movement, measure profiles, construct geologic cross sections, and perform slope-stability analyses to constrain cross sections. | 300 hours |
| 3. Develop a time sequence model for landsliding in cut slopes in the Norwood Tuff. | 80 hours |
| 4. Develop a landslide enlargement model for slides in the Norwood Tuff. | 100 hours |
| 5. Summarize in final technical report. | 120 hours |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Anticipated study period: September 1, 2006 to August 31, 2007

September-November: conduct geologic mapping, profiling, and movement monitoring; collect soil samples for shear strength testing

September-June: collect climatic and ground-water data

November-January: conduct shear strength testing (USGS, Golden, CO);

February-March: prepare draft technical report

April-July: conduct geologic mapping, profiling, and movement monitoring;

July-August: finalize report

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
 Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Utah Geological Survey, Geologic Hazards Program in cooperation with the U.S. Geological Survey, Landslide Hazards Program

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
 Deliverable is a final technical report summarizing results that includes tabulated shear strength data, impact assessment data, detailed landslide deformation maps, landslide movement plots, cut-slope landslide sequence data, and landslide enlargement model.

8. Describe how will this project be implemented at UDOT.

Report will be a possible reference document for future repair and landslide stabilization projects.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Report will provide basis for assessing long-term performance of highway infrastructure along State Routes 167 and 226 and for realistic and cost-effective future design, repair, and stabilization options.

10. Describe the expected risks, obstacles, and strategies to overcome these. Documented slow movement rates in some landslides in the Norwood Tuff may preclude detection of movement over the short duration of the study period. Continued monitoring by the UGS in these areas beyond the study period may provide data on movement, but would not be documented in the final technical report. Sample availability is in part a function of exposures in natural landslides.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Leslie Heppler (Geotechnical Division)

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$15,000 (UTRAC amount) plus \$9,400 (UGS cost share) – approx 60/40 cost share

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Gary Christenson	Utah Geological Survey	537-3304
B) Rex Baum	U.S. Geological Survey, Landslide Hazards Program	(303) 273-8610
C) Austin Rowser	Morgan County Engineer	(801) 845-4094
D) Daniel Horns	Utah Valley State College	863-8582
E) Darin Sjoblom	Utah Department of Transportation	964-4474
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: U.S. Geological Survey, Landslide Hazards Program; Utah Division of Emergency Services; Morgan County

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Investigation for Utah County Liquefaction Hazard Maps

No.: 06.07-4

Submitted By: Travis Gerber and Steven Bartlett

E-mail: bartlett@civil.utah.edu
tgerber@byu.edu

1. Briefly describe the problem to be addressed:

The Utah Liquefaction Advisory Group is currently pursuing funding from the United States Geological Survey (USGS) as part of the NEHRP (National Earthquake Hazards Program) with a project to develop the next generation of liquefaction hazard maps for Utah County. That proposal is an extension in Utah County of a similar project now in progress for the Salt Lake Valley. While relatively abundant data exists in Salt Lake Valley due to extensive land development and reconstruction of the I-15 corridor, less subsurface data exists in Utah County. To help supply the data needed in Utah County, it is proposed that additional CPT sounding data be gathered at locations of particular interest to UDOT (e.g., potential locations for future transportation corridors and interchanges). By participating in the NEHRP program, UDOT will benefit directly from the mapping project by having subsurface data at key locations (bridges, interchanges, new corridors) that will lead to site-specific estimates of liquefaction triggering, lateral spreading, and ground settlement. Additionally, the data will also provide preliminary indications of subsurface conditions, thus making subsequent geotechnical explorations for future UDOT facilities more effective.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

- 1) Obtain CPT soundings for liquefaction hazard assessments at various locations of interest to UDOT within Utah County (UDOT funded part).
- 2) Estimate liquefaction triggering, lateral spread and ground settlement at these locations (NEHRP funded part).
- 3) Produce regional maps for Utah County (NEHRP funded part).

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Meet with UDOT Planning and Project Development Personnel to identify locations that are of interest to them (bridges, interchanges, new construction, etc.).
2. Develop an investigation plan for the sites, balancing available budget with the number of sites, site geology, and CPT depths.
3. Perform CPT soundings (approximately 20).
4. Provide data to UDOT and Utah Liquefaction Advisory Group for further use in creating Liquefaction Hazard Maps.
5. At completion of mapping project, provide estimates of probabilistic liquefaction triggering, lateral spreading, and ground settlement.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Schedule depends upon the number of sites, individual site geology, and the depths investigated. For CPTs ranging in depth from 50 to 100 feet, it is anticipated that 2 to 4 sounding could be completed in a day. Given a budget in the range of \$20k to \$30k, it is anticipated that 14 to 21 soundings could be performed. While CPT sounding can be made year-round, spring and summer time would be preferable.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University (since this is where the NEHRP-sponsored liquefaction hazard mapping is being performed)

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

CPT data and accompanying report from NEHRP project.

When the liquefaction hazard maps are complete, copies of the maps and supporting documentation.

8. Describe how this project will be implemented at UDOT.

CPT sounding data will go to the UDOT Region Project Managers and the Geotechnical group to be used as appropriate in future projects.

The liquefaction hazard estimates from the mapping project will go to the Region, along with the Structures and Geotechnical groups as appropriate in design and construction related activities.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

In leveraging the funding from NEHRP, UDOT will benefit directly from the mapping project by having site-specific estimates of probabilistic liquefaction triggering, lateral spreading, and ground settlement. Additionally, the data will also provide preliminary indications of subsurface conditions, thus making subsequent geotechnical explorations for future UDOT facilities more effective.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The scope of the project is flexible to accommodate needs and budget, but will be finalized with input of the TAC. Project is dependant upon NEHRP funding to develop the hazard maps.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Grant Gummow

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$30k to \$40k

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) Barry Solomon	Utah Geological Survey	
B) Les Youd	Consultant	
C) Clifton Farnsworth	Region 3 Construction	
D) Mark Petersen	United States Geological Survey	
E)		
F)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

UGS, Utah Liquefaction Advisory Group, NEHRP (USGS)

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Biotechnical Stabilization and the use of Phreatophytes

No.: 06.07-07

Submitted By: LA Heppler

E-mail: lheppler@utah.gov

1. Briefly describe the problem to be addressed:

What are the long-term effects to Slope Stability Factor of Safety with the use of Phreatophytes? What is the impact to the material characteristics? What is the impact to pore pressure? What is the impact of root reinforcement?

Strategic Goal: ☒ Preservation ☐ Operation ☐ Capacity ☐ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Measure the effects of planting Phreatophytes on poor soil sites such as slumps and landslides.

2.

3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Access laboratory mud tanks - Define variables, define constants (40 hrs)
2. Create a poor quality of soil in a lab mud tank, divide tank into 2 sections. Run lab tests on material properties (40hrs)
3. Plant one section of the tank with a phreatophytes such as Coyote willows and leave the other half with no vegetation (20 hrs)
4. Let grow (provide acceleration-grow lights, fertilizer) (6 months – manpower would only be 1 hour per week - 30 hrs)
5. Tilt tank and document soil characteristics when failure occurs on both cases. Run lab tests on failed material (40hrs)
6. Compile data and write report. (80hrs)

4. Outline the proposed schedule (when do you need this done, and how we will get there):

As plants need time to grow...the time frame is not critical. Total time frame 1year...actual research hours 250 hours.

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project

Small: ☒ Research Evaluation Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

Other _____

7. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

USU already has mud tanks and student work forces

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) A proven recommendation that planting phreatophytes in problem soils is worth the cost.

8. Describe how will this project be implemented at UDOT. New construction and retrofit existing problem areas

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be. Reduce routine maintenance of some cut slopes and possibly save UDOT the cost of an expensive landslide repair.

10. Describe the expected risks, obstacles, and strategies to overcome these. Doesn't increase the cohesion and phi of the soil. Future studies could include which specific phreatophytes work the best in the different specific UT soil types.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): LA Heppler

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): 250hrs X \$45 = \$12,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Leslie Heppler	Geotechnical Division – Complex	965-4318	Yes
B) Keith Brown	Geotechnical Division – Complex	965-4234	Yes
C) Grant Gummow	Geotechnical Division – Complex	965-4307	Yes
D) Blaine Leonard	Research – Complex	965-4115	Yes
E) Francis Ashland	UGS-DNR	537-3380	Yes
F) Ira Bickford	Maintenance - Complex	965-4119	Yes
G) Lars Anderson	Environmental Manager R-2	887-3470	Yes

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:
Idaho DOT has expressed interest in the past

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Nonlinear Dynamic Behavior of Soils at a Major Structure **No.: 06.07-8**

Submitted By: James A. Bay **E-mail: jim.bay@usu.edu**

1. Briefly describe the problem to be addressed:

A preliminary study performed for the USGS NEHRP program found that Lacustrine silty-clays found at shallow depths exhibit behavior that is more linear than that predicted by commonly used generic empirical models. This means that we might be under-predicting the ground shaking that will occur during seismic events. This proposal is to make some deeper borings at one or more bridge structure to obtain undisturbed soil samples, and perform resonant column testing on the sample to evaluate their nonlinear behavior. Then to compare the ground shaking predicted using the measured and empirical nonlinear properties.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Measure the nonlinear dynamic properties of soil at the site of a major structure.
2. Determine if significantly different levels of ground shaking are obtained using measured rather than generic empirical nonlinear soil properties.
- 3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|---------|
| 1. Obtain undisturbed soil samples | 80 hrs |
| 2. Measure nonlinear behavior of soils | 320 hrs |
| 3. Predict ground shaking using measured and empirical nonlinear properties | 80 hrs |
| 4. | |
| 5. | |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Summer 2006 obtain soil samples

September-December 2006 perform resonant-column tests on soil samples.

January-February 2007 perform Shake analyses

February-April 2007 prepare report

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with the assistance of UDOT

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) 1) Report on the project findings, 2) modulus reduction and damping curves for one major bridge structure site, and 3) a recommendation regarding the use of generic empirical nonlinear dynamic soil properties in site specific ground shaking studies.

8. Describe how will this project be implemented at UDOT.

The results of this project will be a clear recommendation regarding the use of generic empirical nonlinear dynamic soil properties for lacustrine clays along the Wasatch Front. If significant differences in ground shaking are not found in predictions using measured soil behavior, then this project will validate current site specific design procedure. However if significant differences are found, then it will be recommended that Wasatch Front data be compiled to establish empirical predictions specific to this region.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This project will either validate current site specific design procedures, or recommend a course of action to obtain better sites specific ground shakings.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Drilling, sampling and testing procedures used in this work are routine. No significant obstacles are anticipated.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Darin Sjoblom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$24,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)		
B)		
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: USGS, UUSS

2006 RESEARCH PROBLEM STATEMENT

Problem Title:

Measured low-strain site response at a major structure

No.: 06.07-9

Submitted By:

James A. Bay

E-mail: jim.bay@usu.edu

1. Briefly describe the problem to be addressed:

Site specific predictions of ground shaking require both an accurate characterization of the soil layers underlying the site and an accurate characterization of the depth to bedrock. Those two factors will affect the resonant frequency of the site. Unfortunately, very little good data exist on deep soils and depth to bedrock in the Salt Lake and surrounding valleys. One simple way to validate deep models used in analysis is to measure the low-strain dynamic site response of a site. This can be done using small shakers to excite the site. This proposed work is to select one site and use both a very small electro-magnetic shaker and a larger rotating eccentric mass shaker to measure the site response. To evaluate the feasibility of using this technique in routine seismic analysis.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Determining the feasibility of using small shakers to validate deep soil models at the sites of major structures.
- 2.
- 3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|---------|
| 1. Measure site response using small electromagnetic shaker | 32 hrs |
| 2. Measure site response using rotating eccentric mass shaker | 120 hrs |
| 3. Evaluate results | 32 hrs |
| 4. | |
| 5. | |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

June 2006 shake site using electro-magnetic shaker

July-August shake site using rotating eccentric mass shaker

September-October 2006 evaluate results and write report

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with the assistance of UDOT

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.) 1) Report on the project findings, 2) A recommendation regarding the use of small shakers for verifying deep soil models at the site of major structures

8. Describe how will this project be implemented at UDOT.

This project could result in specific recommendations for quick, easy and inexpensive measurements of site response that can be performed at bridge sites. These are not direct measurements of deep soil properties and depth to bedrock, but they can be used to validate models used in analysis.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This project in will result in improved confidence in predicted ground shaking at bridge sites.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Ambient noise levels might interfere with low-strain measurements at bridge sites. Signal processing and averaging techniques will be used to minimize the effects of noise.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Darin Sjoblom

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$7,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)		
B)		
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: USGS, UUSS

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Investigation of Past and Present Corrosion Monitoring, Evaluation, and Mitigation of Bridge Decks **No.:06.08-3**

Submitted By: Marv Halling, Paul Barr **E-mail:** halling@cc.usu.edu

1. Briefly describe the problem to be addressed:

The corrosion of Bridge Decks in the State of Utah is one of the biggest ongoing problems for UDOT Construction and Maintenance. This problem requires a cooperative approach from the bridge design, construction, and maintenance areas in order to be effective. In the past, UDOT has employed various methods for the reduction of corrosion in Bridge decks. Although much can be “borrowed” from the experience of other states, this problem statement is directed at looking at past efforts and outcomes of these efforts.

2. List the research objective(s) to be accomplished:

1. To begin to collect information on whether corrosion measurement instrumentation is practical and useful to UDOT.
2. To investigate corrosion mitigation methodologies that have been employed in the past.
- 3.

3. List the major tasks required to accomplish the research objective(s): **Estimated person-hours**

- | | |
|--|----|
| 1. Prioritize the inventory of bridges with corrosion problems. | 40 |
| 2. Survey the corrosion resisting methods that have been utilized in the past. | 20 |
| 3. Identify two or more types of structures with the worst corrosion problems. | 10 |
| 4. Purchase and install very limited corrosion monitoring systems on two identified bridges. | 20 |
| 5. Collect data for 4 years, and evaluate the usefulness of the collected information. | 80 |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Tasks 1-4 6 months

Task 5. 4 years

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)
Improved design and maintenance methods.

8. Describe how will this project be implemented at UDOT.

The obtained data from this project will be used for minimizing the corrosion problem in the future.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This type of data will be valuable for decision making in the future

10. Describe the expected risks, obstacles, and strategies to overcome these.

Although the instruments and data loggers will be both small and cheap to install, the issues with installation will likely take a significant effort.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): Boyd Wheeler

12. Estimate the cost of this research study including implementation effort . 20 K labor, 15 K equipment = \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A Todd Jensen		
B) Dave Nazare		
C) Dave Eicksenberger (sp?)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: FHWA,

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Dynamic Analysis of Integral Bridge Pier System

No.:06.08-4

Submitted By: Paul Richards (Assistant Professor, BYU)

E-mail: prichards@et.byu.edu

1. Briefly describe the problem to be addressed:

The connection between a steel girder system and concrete column is critical for earthquake resistance. The seismic performance of existing details has not been fully investigated using dynamic loading.

2. List the research objective(s) to be accomplished:

1. Establish the performance and adequacy of typical integral bridge connections in Utah under expected earthquake loading
2. Develop recommendations for improved performance and economy for future connections integrating data from the proposed analyses and findings from other studies.
- 3.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|---|------|
| 1. Review of "typical" details for integral bridge connections | 40 |
| 2. Modeling of representative details using ABAQUS. Full dynamic analysis used to investigate performance | 1000 |
| 3. Correlation of modeling techniques with existing experimental data | 200 |
| 4. Data analysis and report writing | 400 |
| 5. | |
| 6. | |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

Project could be completed within one year.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

1. Evaluation of expected performance of existing integral connections
2. Improved details and design methodology for integral bridge connections

8. Describe how will this project be implemented at UDOT.

1. Research report will be used as resource for disaster planning and future design

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Benefits:

1. Awareness of how current connections will perform to help in disaster planning
2. Potential cost savings if more economical connection with improved performance can be developed

10. Describe the expected risks, obstacles, and strategies to overcome these.

One potential obstacle is model verification. This obstacle will be overcome using a correlation study to verify modeling techniques using experimental data that has been generated for similar connection types. With verified techniques, the connections of interests can be analyzed with confidence.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results):

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$30,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A)		
B)		
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

2006 RESEARCH PROBLEM STATEMENT

Problem Title: Develop overhead sign structure standard drawings

No.:06.08-5

Submitted By: Jason Phillips

E-mail: jphillips@hwlochner.com

1. Briefly describe the problem to be addressed:

Currently in Utah each individual overhead sign structure is geometrically designed, structurally designed and then construction drawings and details are developed.

This problem statement proposes to establish design criteria for and to develop standard structural drawings for overhead sign structures.

Strategic Goal: ☐ Preservation ☐ Operation ☐ Capacity ☒ Safety (Check all that apply)

2. List the research objective(s) to be accomplished:

1. Investigate and establish parameters to develop design zones for various wind load conditions throughout the state.
2. Evaluate typical UDOT details to verify they meet current industry standards.
3. Establish a design philosophy and design criteria.
4. Proceed with design and develop standard structural drawings for overhead sign structures.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

- | | |
|--|------|
| 1. Meet to discuss and establish UDOT/Consultant design and review team | 10 |
| 2. Establish design criteria | 20 |
| 3. Develop standard designs for 25 different cantilever and 10 different full-span sign panel and span length combinations | 1200 |
| 4. Review team to comment on design and detailing | 200 |
| 5. Finalize standard drawings and design | 200 |
| 6. Develop general notes and methodology for application | 50 |
| 7. Approve drawings | 10 |

4. Outline the proposed schedule (when do you need this done, and how we will get there):

obtain funding, select design and review team – April/May 2006

develop design – summer 2006

review design – fall/winter 2006

approve standard drawings - winter 2006/2007

apply to projects and save UDOT money - 2007 and on

5. Indicate type of research and / or development project this is:

Large: ☐ Research Project ☒ Development Project
Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

Consultant

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Standard structural drawings ready for use for various wind loads, dimensions and sign panel sizes and configurations for full span and cantilever sign structures.

8. Describe how this project will be implemented at UDOT.

Designers will develop signing plans and establish the location, height and size of overhead sign panels and the sign structure. The designer will then apply this geometric information to the standard overhead sign structural drawing to establish the "line and column" and associated structural information required for the established sign geometry. Labor associates with development, review and approval of custom structural design of each individual overhead sign structure will be eliminated.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

Project staffing, budgets and delivery schedules will directly realize the benefit. Design and review time will be reduced. Construction costs will decrease as fabricators work from standard fabrication details instead of custom individual designs.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Soil parameters are different at each project site. Foundation assumptions will be stated and if soil conditions are outside of the established parameters a specific foundation will need to be designed.

11. List the key UDOT Champion of this project (UDOT employee who will help Research Division steer and lead this project, and will spearhead the implementation of the results): BOYD WHEELER

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$150,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone
A) DEGEN LEWIS	ASSISTANT TRAFFIC ENGINEER, UDOT REGION 3	801-222-3401
B) BRIAN BYRNE	STRUCTURAL ENGINEER – HW LOCHNER	860-513-4003
C)		
D)		
E)		
F)		
G)		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study: UDOT Traffic and safety and pre-construction

RESEARCH PROBLEM STATEMENT

Problem Title: Critical Slope for Trench Drain Installations

No.:06.09-3

Submitted By: UDOT Central Hydraulics; Michael Fazio

E-mail: mfazio@utah.gov

1. Briefly describe the problem to be addressed:

Trench or Line Drains are drainage systems that are preformed or prefabricated of various materials, including polyethylene. They are usually 6 to 12-inches wide and can be as long as needed. The drains are usually installed on or near the edge of paved roads where they collect runoff from off the road surface. Some of these products can be very hydraulically efficient. Their design seems especially applicable on roads with a nearly flat longitudinal slope, where sometimes puddles form on the shoulders because of poor drainage capacity.

Several trench drains systems have been installed in Utah. At this time, some installations are all clogged with debris. In some installation, weeds are growing in the drain where all the debris was collected. Most debris comes from the winter snow removal operation. During winter snow removal, salt and sand is spread on the roadway surface to improve pavement friction. The salt and sand is moved by the tire action and pavement cross slope to the edges of the road where the drains are. As the debris enters the drains, it builds up, occluding the drain. The sand applied during the snow season, along with other silt and debris, finds its way into storm water systems causing a loss of capacity in the system. This loss can potentially cause the excessive spread of water into the traveled roadway, which may lead to vehicles hydroplaning.

This research study would investigate the reason of the drain clogging and help us determine the most effective slope and shape of trench drain that would induce self-cleansing velocities from sediment found on Utah roadways.

2. List the research objective(s) to be accomplished:

1. Research reasons for the trenches clogging.
2. Develop minimum standard requirements that would reduce the potential for the trench drains to clog.
3. Prepare standard specification and drawings for the department.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Investigate current installations. 2. Set-up lab experiment using various types of drains at various slope and debris loading. 3. Collect information to determine minimum requirements for slope, width, opening. 4. Prepare report. 5. Prepare Standard Details and Specifications.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

The research should be completed in a year.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
Small: ☒ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University with water lab.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

A final report with all needed findings to prepare standard specifications.

Standard Specifications.

Standard Drawings.

8. Describe how will this project be implemented at UDOT.

A new UDOT's Standard Specification and drawing for the use of the Departments Engineers and consultants when designing trench drain systems.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

This study will allow the optimal design of trench drains producing a more effective roadway drainage system. An efficient drainage system will provide safer driving conditions and reduce maintenance costs related to cleaning out the systems. The traveling public is the ultimate beneficiary.

10. Describe the expected risks, obstacles, and strategies to overcome these.

At this time there is no expected risks associated with the research.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Michael Fazio, Denis D. Stuhff UDOT Central Hydraulics

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): ABT would be willing to participate materially and financially to the completion of this study. The cost to the Department could vary from \$10,000 to \$30,000.

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

	Name	Organization/Division/Region	Phone	Attended UTRAC?
A)	Michael Fazio	UDOT Central Hydraulics	801-957-8556	X
B)	Tim Ularich	UDOT Central Hydraulics	801-965-4038	X
C)				

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Calibration of Curve Numbers (CN) for estimating runoff in rural ungaged streams in Utah No.:06.09-4

Submitted By: Michael Fazio

E-mail: mfazio@utah.gov

1. Briefly describe the problem to be addressed:

The NRCS method and relative Curve Numbers has not been researched properly. The model is so robust and stable that it is useful even when the values used are non-optimal. In Utah our NFF regional regression equations handle small to mid-sized "undeveloped" catchments only in Hydrologic Study Regions 1, 6 and 8. Hydrologic Study Region 1 is the high altitude region. The error of Hydrologic Study Region 6 is so high it is reported in log units and the equivalent years of record for some recurrence intervals of interest are measured in only fractions of a year. The runoff curve number approach would provide an alternate simple method which would allow us to better evaluate NFF design flows and to also estimate flows in disturbed and developing basins. Other regional regression equations have lower limits or minimum sizes of drainage for which these equations apply ranging from 1300 to 3600 acres leaving a simple Hydrologic tool "gap" that must be filled by other methodologies such as the runoff curve number approach.

The method should be improved or enhanced for best use in Utah. For best achievable accuracy, these CN's should be "adjusted" for our arid & semi-arid climate zones. By picking gaged basins, CN's could be determined based on regional Utah data. One logical set of parameters to use would be easily identified biomes or vegetation types such as: Montane, Pinyon-Juniper, Sagebrush, Shadscale, Creosote Bush & Saline Desert Zones. (The Texas Department of Transportation (TxDOT) completed a similar research entitled "Climatic Adjustments of Natural Resource Conservation Service (NRCS) Runoff Curve Numbers: Final Report", Report No. 0-2104-2 by David Thompson et al of Texas Tech University)

The usefulness of this kind of basic fundamental research work to the orderly and economic development of the infrastructure is by itself very significant. No other similar models are as simple (essentially only one lumped parameter), useful (can be used in both developed and undeveloped catchments), and stable (you have to work harder to mess up) of the runoff curve number approach for catchments greater than 200 to 300 acres (the generally recommended upper limit for the rational formula $Q = CiA$ method).

2. List the research objective(s) to be accomplished:

1. Calibrate CNs in for all Utah Hydrologic Regions.
2. Present all calibrations in a report, showing methods of calibration and location where numbers were calibrated.
3. Present calibrated numbers in a format that can be used in WMS.
4. Provide training on how to use CN to all UDOT designers.

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

Task1 – Collect historical rainfall/runoff data to adjust for Utah topography and climatology.

Task 2 – Provide database of rainfall/runoff events that can be used in this and future research.

Task 3 – Provide a report on feasibility of using it to develop regionally adjusted CN factors for Utah will be created. Included in this report will be a recommended plan of action and associated limitations.

Task 4 – Provide calibrated CNs in format that can be used in WMS.

Task 5 – Provide training for UDOT designers on how to use the method and the CNs.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

One year completion.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Report with calibrated CNs, CNs formatted for use in WMS, Training for designers.

8. Describe how will this project be implemented at UDOT.

UDOT Designers will use the calibrated numbers to estimate runoff at stream crossings.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

A better estimate of flow at stream crossings for sufficient culvert/bridge capacity.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Insufficient data for the calibration of the CN numbers.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): *Michael Fazio, Denis Stuhff, Tim Ularich*

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$35,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Brandon Tucker	Region One Hydraulics Engineer		
B) Daryl Friant	Region 4 Hydraulics Engineer		
C) Marwan Farah	Region 2 Hydraulics Engineer		

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

State of Utah Engineer's Office

USACOE

Other Local Agencies

RESEARCH PROBLEM STATEMENT

Problem Title: *Calibration of time parameters and synthetic unit hydrograph coefficients for Utah watersheds*

No.:06.09-5

Submitted By **Sanja Perica, University of Utah**

E-mail: perica@eng.utah.edu

1. Briefly describe the problem to be addressed:

Because of the importance of runoff timing, most hydrologic models require a watershed characteristic that reflects the runoff travel time. The most frequently used time parameters in hydrologic models are the time of concentration and the lag time. Time parameters for hydrographs for ungaged watersheds are usually estimated using empirical formulas. For example, a lag time is defined in terms of the physical characteristics of the watershed, such as drainage area, channel length and channel slope. However, most of these formulas have been based on very limited data and should be used with considerable caution for watersheds in which physical characteristics are different from those of the watersheds used to calibrate the formula and that are outside the geographic region for which the formula was developed. For example, the widely used Kirpich's formula for lag time was developed based on a study of small agricultural watersheds in Tennessee. The hydrographs developed using the commonly used NFF Regression Equations default to parameters developed for Georgia. No studies are available for semi-arid Utah watersheds. It is no surprise that when tested on a watershed in Utah (Red Butte Canyon, 7.2 mi²), lag time estimates for the watershed varied from 12 minutes to 7 hours, depending on the formula used.

2. List the research objective(s) to be accomplished:

1. **Major objective:** To develop reliable estimates of lag time and time of concentration parameters for typical Utah watersheds.
2. To provide regional estimates of empirical coefficients used in most accepted synthetic unit hydrograph methods; such as a peaking coefficient needed for Snyder's synthetic unit hydrograph method and a storage coefficient used in Clark's method.
3. To create a regional synthetic unit hydrograph to be used in hydrologic models, such as HEC-HMS (HEC-1), for rainfall-runoff transformation

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Develop a database of short-interval (5-, 10-, 15-min) rainfall and runoff data for as many rural watersheds in Utah as possible.
2. Use watershed modeling system (WMS) software to estimate a number of physiographic characteristics of each watershed that will be explored as possible predictors of time parameters.
3. Estimate lag time and time of concentration parameters based on collected rainfall-runoff events.
4. Develop empirical equations that will relate lag time parameter to selected watershed characteristics.
- 5 Use HEC-HMS program to calibrate empirical coefficients of two existing and widely used synthetic unit hydrograph methods, or, if feasible, develop a new synthetic unit hydrograph for the region.
6. Depending on the number of watersheds that will be available for analysis, a regional analysis, or separation of watersheds based on land uses, may be attempted.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

It is estimated that approximately 18 months will be needed to complete the project:
 6 months for data collection, quality control and database development
 6 months for HEC-HMS and WMS runs
 6 months for model calibration.

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project
 Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :
☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Short Manual containing practical examples, demonstrating how to apply these coefficients to common problems.

8. Describe how will this project be implemented at UDOT.

The Manual will be distributed to Region Roadway Designers & Hydraulic Engineers and incorporated into the Departments Hydraulic Manual of Instruction for the use of Consultants and others doing drainage designs for the Department.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The availability of Regionally calibrated hydrographs will allow flood routing and the optimal sizing of drainage structures. This will minimize both structure costs and environmental impacts.

10. Describe the expected risks, obstacles, and strategies to overcome these.

Selection of appropriate Regionally representative gaged drainage basins. Using the knowledge of Statewide conditions, which have been acquired by previous Regression Equation work within Utah, and bounding States will facilitate this problem.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results):

Denis Stuhff, UDOT Hydraulic Engineer.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3):\$57,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Dr. Sanja Perica	University of Utah		X
B) Michael Fazio	UDOT Central Hydraulics		X
C) Tim Ularich	UDOT Central Hydraulics		X
D) Jerry Channey	UDOT Environmental Division		X
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

RESEARCH PROBLEM STATEMENT

Problem Title: Assessing ownership and location of storm drains and sewer within UDOT Right of Way No.:06.09-6

Submitted By: Michael Fazio

E-mail: mfazio@utah.gov

1. Briefly describe the problem to be addressed:

Many storm drains and sewers have been installed in UDOT Right of Way in urban areas, by UDOT and local government, to collect storm water and provide a safer ride for the public. Some of these systems are falling in disrepair, becoming a potential danger to the public because of failure. Just last year, during the spring thaw and rains, at least 4 storm drains failed in the Wasatch front. Storm drain failures usually come unexpectedly and cause a lot of damage. To prevent unexpected failures, the Department needs to be aware of the conditions of the infrastructure and provide necessary repairs. We have four types of systems in UDOT's Right of Way: 1. Systems of known ownership, where the owner provides needed regular maintenance of the system. The condition of these systems is usually good. 2. Systems of known ownership where the owner is not providing needed maintenance because of lack of funds or inaccessibility. 3. Systems where the ownership is contested and/or ignored. Local government believe the systems belong to UDOT and do not provide necessary repairs and likewise UDOT personnel sometimes believes some systems do not belong to UDOT so they do not provide needed maintenance. 4. Unknown system. Systems that were placed long time ago and have been forgotten.

This study focuses especially on the last two types, but the final product will include all the systems in UDOT's ROW. The study will provide knowledge of outfall location for the NPDES II requirement to map all storm drain outfall into waters of U.S. It will provide a structure for future development permit issues.

2. List the research objective(s) to be accomplished:

1. Document ownership of all storm drains installed within UDOT's ROW
2. Organize information in database and Arcinfo
3. Distribute information to interested parties

3. List the major tasks required to accomplish the research objective(s):

Estimated person-hours

1. Collect all documents about installation of storm drain systems in UDOT's ROW, including agreements, maps, and any other pertinent document.
2. Review documents and records that have storm drain installation for applicability.
3. Place all relevant information in database and arcinfo.
4. Field-verify installation or consult with maintenance stations supervisors to verify existence of system or find our of unmapped systems.
5. Up-date database and arcinfo
6. Meet with local officials and region manager to present findings.

4. Outline the proposed schedule (when do you need this done, and how we will get there):

This project may take up to two years.

Phase 1A, Collect all information from documents (1 year)

1B, Place information in database (consequent and consecutive of phase 1A)

1C, Verify information collected (2 months)

2, Map information (3 Months)

3, Distribute information (3 months)

5. Indicate type of research and / or development project this is:

Large: ☒ Research Project ☐ Development Project

Small: ☐ Research Evaluation ☐ Experimental Feature ☐ New Product Evaluation ☐ Tech Transfer Initiative :

☐ Other _____

6. What type of entity is best suited to perform this project (University, Consultant, UDOT Staff, Other Agency, Other)?

University or consultant may be able to complete this work. Since it is labor intensive, universities may be able to provide a more cost efficient service than consultants.

7. What deliverable(s) would you like to receive at the end of the project? (e.g. useable technical product, design method, technique, training, workshops, report, manual of practice, policy, procedure, specification, standard, software, hardware, equipment, training tool, etc.)

Database with all the storm drain within UDOT ROW inventoried.
System mapped in arcinfo for the region personnel use.

8. Describe how will this project be implemented at UDOT.

Malignance personnel will use this to identify the systems to maintain. Permitting officers and region engineer need to know and understand what is the existing system capacity to be able to add more flow to their systems.

9. Describe how UDOT will benefit from the implementation of this project, and who the beneficiaries will be.

The ultimate beneficiaries will be the public. The region hydraulic and maintenance engineer, the permitting officers and maintenance personnel will greatly benefit by knowing what the system is, where it is and who owns it. It will simplify the permitting process to add new systems to what is existing and provide direct access to important information to decision-makers.

10. Describe the expected risks, obstacles, and strategies to overcome these.

The major obstacles will be finding all that is out there. I do not perceive and risks or other obstacles at this time.

11. List the key UDOT Champion of this project (person who will help Research steer and lead this project, and will participate in implementation of the results): Michael Fazio, Marwan Farah, Shawn Debenham, John Higgins, Paul Egbert, Kris Peterson.

12. Estimate the cost of this research study including implementation effort (use person-hours from No. 3): \$20,000 - \$50,000

13. List other champions (UDOT and non-UDOT) who are interested in and willing to participate in the Technical Advisory Committee for this study:

Name	Organization/Division/Region	Phone	Attended UTRAC?
A) Rick Olsen	Salt Lake County	468-3731	
B) Paul Hawker	Utah County	851-8603	
C)			
D)			
E)			
F)			
G)			

14. Identify other Utah agencies, regional or national agencies, or other groups that may have an interest in supporting this study:

The major cities and counties on the Wasatch front.

APPENDIX A

WORKSHOP AGENDA

-AGENDA-
UTRAC WORKSHOP 2006

Salt Lake Community College-Miller Campus
9750 South 300 West
Sandy, Utah

Tuesday, March 21, 2006

Registration & Continental Breakfast:

Karen G. Miller Conference Center (KGMC)

7:30 am - Noon *Workshop Registration*

Introductory Plenary Session:

KGMC

8:30 am - 9:30 am *Welcome – Rukhsana Lindsey, Director of Research*
Keynote Address – John Njord, UDOT Executive Director
Research Program Status – Blaine Leonard, Research Project Manager
Workshop Instructions - Blaine Leonard, Research Project Manager

Morning Break:

KGMC-Main Foyer

9:30 - 10:00 am *Workshop sponsored break*

First Breakout Session:

KGMC and Miller Professional Development Center(MPDC)

10:00 am - 11:45 pm *Problem presentations, discussion, and first prioritization voting*
(See map for room assignments)

Workshop sponsored lunch:

KGMC

11:45 - 1:30 pm *Lunch*
Presentation of Trailblazer Award – Rukhsana Lindsey, Dir. of Research
Award of Door Prizes – Barry Sharp, New Products Coordinator

Second Breakout Session:

KGMC and MPDC

1:30 pm - 3:00 pm *Problem Statement Refining: Objectives, Tasks, Benefits, Implementation*

Afternoon Break:

KGMC Main Foyer

3:00 pm - 3:30 pm *Workshop sponsored break, Networking on Problem Statements*

Third Breakout Session:

KGMC and MPDC

3:30 pm – 4:30 pm *Problem Statement refinement & discussion:*
Deliverables, Tasks & Budget
Final Prioritization Voting
Completion of Workshop Feedback and Evaluation

Adjourn Workshop: 4:30 pm

APPENDIX B

WORKSHOP ATTENDEES

UTRAC 2006 ATTENDEES

Mr. Steven Acerson
UDOT REGION 3
Group 2

Mr. Glen Ames
UDOT SYSTEMS PLANNING
Group 5

Mr. Douglas Anderson
UDOT RESEARCH
Group 3

Mr. Lars Anderson
UDOT REGION 2
Group 4

Ms. Linda Anderson
FHWA
Group 4

Dr. Loren Anderson
UTAH STATE UNIVERSITY
Group 7

Mr. Scott Andrus
UDOT REGION 3
Group 1

Mr. Francis Ashland
UTAH GEOLOGIC SURVEY
Group 7

Dr. Paul Barr
UTAH STATE UNIVERSITY
Group 8

Dr. Steve Bartlett
UNIVERSITY OF UTAH
Group 7

Dr. Jim Bay
UTAH STATE UNIVERSITY
Group 7

Mr. Austin Baysinger
UDOT SYSTEMS PLANNING
Group 3

Mr. Ken Berg
UDOT RESEARCH
Group 6

Mr. Tim Biel
UDOT MATERIALS
Group 3

Mr. Jon Bischoff
UDOT GEOTECHNICAL
Group 7

Mr. Ben Blankenship
ASH GROVE CEMENT
Group 3

Mr. Doyt Bolling
UTAH T2 CENTER
Group 3

Mr. Hugh Boyle
MICHAEL BAKER
Group 8

Mr. Keith Brown
UDOT GEOTECHNICAL
Group 7

Mr. Steve Call
FHWA
Group 5

Mr. Jerry Chaney
UDOT ENVIRONMENTAL
Group 4

Mr. Dan Church
PARSONS BRINCKERHOFF
Group 8

Mr. Rob Clayton
UDOT TRAFFIC & SAFETY
Group 6

Mr. Ryan Cole
IGES
Group 7

Mr. Ray Cook
UDOT STRUCTURES
Group 8

Mr. Jim Cox
UDOT REGION 3
Group 3

Mr. J. R. Duncan
ASH GROVE CEMENT
Group 3

Mr. Paul Egbert
UDOT
Group 4

Mr. David Eixenberger
UDOT STRUCTURES
Group 8

Mr. Todd Emery
FHWA
Group 3

Mr. Clifton Farnsworth
UDOT REGION 3
Group 7

Mr. Michael Fazio
UDOT HYDRAULICS
Group 9

Mr. Wayne Felix
UDOT REGION 1
MATERIALS
Group 3

Mr. Liam Fritzgerald
UDOT MAINTENANCE
Group 2

Mr. Larry Gay
UDOT REGION 4
Group 3

Dr. Travis Gerber
BRIGHAM YOUNG
UNIVERSITY
Group 7

Mr. Darrell
Giannonatti
UDOT CONSTRUCTION &
MATERIALS
Group 1

Mr. Brad Giles
WAVETRONIX
Group 6

Mr. Chris Glazier
UDOT ISS
Group 10

Mr. Jim Golden
UDOT REGION 3
Group 1

Mr. Kevin Griffin
UDOT REGION 1
Group 2

Mr. Grant Gummow
UDOT GEOTECHNICAL
Group 7

Dr. Spencer Guthrie
BRIGHAM YOUNG
UNIVERSITY
Group 3

Mr. Todd Hadden
UDOT
Group 5

Dr. Marv Halling
UTAH STATE UNIVERSITY
Group 8

Mr. Corbett Hansen
KLEINFELDER
Group 7

Mr. Logan Harris
WAVETRONIX
Group 6

Mr. Rex Harris
UDOT REGION 1
Group 10

Mr. Dal Hawks
UDOT REGION 4

Ms. Debbie Heim
UDOT RESEARCH
Group 9

Ms. Leslie Heppler
UDOT GEOTECH
Group 7

Mr. Jim Higbee
UDOT GEOTECHNICAL
Group 7

Dr. Rollin Hotchkiss
BRIGHAM YOUNG UNIV
Group 9

Mr. Daniel Hsiao
UDOT RESEARCH
Group 8

Mr. Robert Hull
UDOT TRAFFIC AND
SAFETY
Group 6

Mr. Ahmad Jaber
UDOT SYSTEMS PLANNING
Group 5

Mr. Peter Jager
UDOT TRAFFIC & SAFETY
Group 6

Mr. Brent Jensen
UDOT ENVIRONMENTAL
Group 4

Ms. Rae Ann Jensen
UDOT RESEARCH

Mr Terry Kenney
USGS
Group 9

Mr. Cameron Kergaye
UDOT PROJECT
DEVELOPMENT
Group 5

Mr. Dave Kinncom
UDOT TOC - ITS
Group 6

Mr. Gary Kuhl
UDOT SYSTEMS PLANNING
Group 3

Mr. Bill Lawrence
UDOT SYSTEMS PLANNING
Group 5

Mr. Blaine Leonard
UDOT RESEARCH
Group 7

Ms. Shana Lindsey
UDOT RESEARCH
No Group

Mr. Vincent Liu
UDOT
Group 6

Kelly Lund
FHWA
Group 5

Mr. Carlos Machado
FHWA
Group 5

Mr. Clark Mackay
UDOT REGION 4
Group 1

Mr. Shane Marshall
UDOT ENVIRONMENTAL
Group 4

Mr. Mike Marz
UDOT
Group 5

Mr. Raeleen Maxfield
UDOT CONSULTANT
SERVICES

Ms. Mitzi McIntyre
UTAH CHAPTER ACPA
Group 3

Mr. Jim Mcminimee
UDOT PROJECT
DEVELOPMENT

Mr. John Miller
UDOT REGION 2
Group 8

Mr. Richard Miller
UDOT PROJECT
DEVELOPMENT
Group 10

Mr. John Njord
UDOT EXECUTIVE
DIRECTOR
No Group

Mr. L. Scott Nussbaum
UDOT REGION 1
Group 2

Ms. Esther Olsen
UDOT RESEARCH
No Group

Ms. Michelle Page
UDOT REGION 2
Group 1

Mr. Randy Park
UDOT REGION 2

Mr Ralph Patterson
UDOT TRAFFIC
MANAGEMENT
Group 6

Dr. Joe Perrin
UNIVERSITY OF UTAH
Group 6

Mr. Kris Peterson
UDOT REGION 2
Group 6

Mr. Brian Phillips
UDOT REGION 3
Group 2

Mr. Jason Phillips
HW LOCHNER

Mr. Brad Price
RB&G ENGINEERING
Group 7

Mr. Greg Punske
FHWA
Group 4

Mr. George Ramjoue
WASATCH FRONT REGIONAL
COUNCIL
Group 5

Mr. Eric Rasband
UDOT
Group 5

Dr. Larry Reaveley
UNIVERSITY OF UTAH
Group 8

Mr. Paul Richards
BRIGHAM YOUNG UNIV
Group 8

Mr. Matt Rink
UDOT STRUCTURES
Group 8

Dr. Kyle Rollins
BRIGHAM YOUNG UNIV
Group 7

Dr. Pedro Romero
UNIVERSITY OF UTAH
Group 3

Dr. Keri Ryan
UTAH STATE UNIV
Group 8

Dr. Mitsuru Saito
BRIGHAM YOUNG UNIV
Group 6

Dr. Grant Schultz
BRIGHAM YOUNG UNIV
Group 5

Mr. Brent Schvaneveldt
UDOT REGION 3

Mr. Kim Schvaneveldt
UDOT PLANNING
Group 5

Mr. Ernie Scott
INTER-MOUNTAIN LABS
Group 2

Mr. Barry Sharp
UDOT RESEARCH
Group 2

Mr. Sam Sherman
ITERIS
Group 6

Mr. Darin Sjoblom
UDOT GEOTECH
Group 7

Mr. Roland Stanger
FHWA
Group 6

Dr. Aleksandar
Stevanovic
UNIVERSITY OF UTAH
Group 6

Mr. Matthew Swapp
UDOT SYSTEMS PLANNING
Group 5

Mr. Peter Tang
UDOT TRAFFIC & SAFETY
Group 6

Mr. Everett Taylor
FHWA
Group 8

Mr. Rodney Terry
UDOT REGION 1
Group 3

Mr. Tom Twedt
BIO-WEST
Group 4

Mr. Karl Verhaeren
UDOT CONSTRUCTION
Group 1

Mr. Abdul Wakil
UDOT RESEARCH
Group 5

Mr. Paul West
UDOT ENVIRONMENTAL
Group 4

Mr. Boyd Wheeler
UDOT STRUCTURES
Group 8

Mr. Robert Wight
UDOT REGION 2
Group 1